SCIENCE

FRIDAY, FEBRUARY 13, 1914

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE CARNEGIE INSTITUTION OF WASHINGTON[1]

IT is a source of satisfaction to record that the experience of the past year supplements that of a year ago in showing a general improvement in the relations which the institution sustains to other organizations and to the world of learning at large. The obviously rational tendency to take an objective view of the institution and its work and to measure them by the more permanent standards available is now everywhere distinctly visible. This tendency is manifested in many ways: by an increasing demand for exact information concerning the plan, scope and development of the institution as a whole; by an increasing critical interest in the investigations, the equipments and the programs of work of our departments of research; and by an increasing demand for precise knowledge concerning special apparatus and special technique developed by our departmental staffs. In addition to these numerous demands for correct information with respect to ways, means, methods and results, there are now presented also, not infrequently, requests for investigations in cooperative enterprises for which other organizations, or in some cases individuals, are willing to supply the necessary funds. This is a manifestation which, while not unanticipated, has developed somewhat earlier than expected. It calls for considerate attention, since it is likely to grow with time in proportion as the institution demonstrates capacity for trustworthy

[1] From the report of the president for the year ending October 31, 1913.

management of funds and for effective conduct of research.

On the death of Dr. Fletcher, November 8, 1912, editorial supervision of the *Index Medicus* was placed in charge of Dr. Fielding H. Garrison, who had long been associated as principal assistant with Dr. Fletcher in the publication of this work. Continuity of plan and purpose is thus assured in the perpetuation of this current bibliography, while the responsible editorship falls to one whose qualifications for the task have met the exacting standards of his eminent predecessors.

In accordance with the authorization voted by the Board of Trustees at its meeting of December 13, 1912, a department of human embryology, under the direction of Professor Franklin P. Mall, with a small staff of associates and collaborators, has been planned and is already engaged in active research. In arranging for this department the institution is peculiarly fortunate not only in enlisting the directorship of Professor Mall, but in starting from a foundation furnished by his remarkable collection of human embryos. It will be seen also that this enterprise is of far greater import than might at first appear, for it has fundamental relations to the science of anthropology as well as to those of anatomy, physiology and pathology, which latter, indeed, from some points of view, may not improperly be regarded as branches of the former widely inclusive science. The efforts of the institution to enter the domain of anthropology, to which reference is again made in a later section of this report, are thus in part realized in a most effective way.

Another noteworthy event of the year is the construction of two new buildings, a heating and lighting plant, and an additional laboratory, for the department of experimental evolution, authorized by the board of trustees at their last meeting. Plans in illustration of these buildings, which are now nearing completion, will be found in connection with the annual report of the department in the current year book. Two of the many uses which this laboratory is designed to serve in the immediate future are those of housing and further experimentation upon the unique collection of pedigreed pigeons, studied for many years by the late Professor C. O. Whitman, whose researches the institution has undertaken to complete and to publish. In accordance with the agreement entered into with Professor Whitman's heirs this unrivaled collection of biological material will become the property of the institution, and arrangements have been made for its transfer to Cold Spring Harbor from Chicago before the end of the calendar year.

Similarly, two items from the current history of the department of terrestrial magnetism are worthy of mention here. One of these is the approaching completion of an office and laboratory building whose construction was approved by the board of trustees a year ago. Floor plans of this building are incorporated in the annual report of the director of the department in the current year book. The building is situated on a very favorable, elevated site of a little less than seven acres in the District of Columbia, near Chevy Chase, and near the western boundary of Rock Creek Park. It will be fireproof, will furnish safe storage for the extensive records already acquired by the department, and will afford opportunity for experimental researches in terrestrial magnetism which may be confidently expected to give deeper insight into this obscure but at present highly utilitarian property of our planet. The other noteworthy event referred to is the near com-

pletion of a circumnavigation voyage of about three and a half years' duration and of courses aggregating upwards of 80,000 miles, by the non-magnetic ship *Carnegie*. Experience with this ship shows that a magnetic survey of the oceans is a somewhat less formidable undertaking than a magnetic survey of the continents, for the latter are still, on the whole, less accessible than the former since the advent of this non-magnetic nautical observatory. Great credit is due to Mr. W. J. Peters, commander of this ship, for assiduous attention not only to her safety, but also to the effectiveness of her mission in the immediate interests of the world's navigation and in the more important, though less obvious, interests of terrestrial physics.

Reference was made in the report of a year ago to the construction of a fireproof office building at Pasadena, California, for the staff of the solar observatory. This building has been occupied during the past year, and its characteristics are shown by illustrations in photo-perspective and in plan in the current year book. In addition to supplying adequate quarters for the departmental staff and safe storage for the extensive records of the observatory, it furnishes in its sub-basement a constant-temperature room in which will be installed a dividing engine designed especially to rule diffraction gratings for use with the other optical apparatus of the observatory. Such an engine has been constructed at the shops of the observatory during the past year by Mr. Jacomini, mechanician of the departmental staff, in collaboration with Dr. John A. Anderson, of Johns Hopkins University, who has supplied tests of precision which have led to a degree of perfection not hitherto attained in this excessively difficult and delicate kind of construction. It is gratifying to report also in this connection that the glass disk for the 100-inch telescope, which a year ago had developed distortions indicating defective stability, is now meeting all essential requirements and giving promise of an optical surface equal to, if not superior to, that of the 60-inch mirror. Accordingly, work of construction for the foundation and for the mounting of this 100-inch telescope is now proceeding as rapidly as the conditions of safety and of efficiency in such a novel undertaking will permit.

OUTLINE OF RESEARCHES OF THE YEAR

As is abundantly indicated in previous reports, and as is evident to any deliberate reader of the bewildering miscellanies presented in the year books, the diversity and the complexity of the investigations going forward under the auspices of the institution preclude anything like a clear and complete summary of their scope, progress and prospective value within the limits of an administrative report. The general reader must take it for granted (provisionally at least) that these investigations are in the main worth undertaking and thus await the verdict of time through the aid of a growing critical public opinion; for in proportion as such investigations are fundamental, and hence worth carrying on, they will be difficult of exposition and more difficult of comprehension. Concerning this matter there appears to be prevalent a popular fallacy to the effect that writers untrammeled by competent scholarship, but who possess verbal facility, are better qualified to expound a technical subject than those who have developed it or contributed thereto; and along with this fallacy there is frequently coupled another to the effect that ours is an age of narrowing specialization, whose evil effects may be remedied by resort to literary views of phenomena and by re-

stricting the range of increasing knowledge. While patiently tolerant with these extremes of opinion, it is obviously inadmissible to adopt either of them here. We may neither pretend to exposition of knowledge not acquired nor deprecate the excess of knowledge possessed by experts in this or that field of science. It is hoped, therefore, that the brief summaries given in the president's reports may not be mistaken for adequate accounts of current progress or for sufficient recognition of the merits of the researches referred to.

DEPARTMENTS OF RESEARCH

In accordance with the views just set forth it seems appropriate at this time to limit still more narrowly than hitherto the brief summaries of departmental work and to invite attention still more directly to the departmental reports published in the year book. All of the departments of research of the institution hitherto reported upon are now well-defined organizations, each of them independent of and more or less isolated from the others, and each of them devoted to a field which, while in some cases related to, does not encroach upon the fields of others. Each of them possesses thus a degree of autonomy which calls for a corresponding degree of freedom in the rendition of annual reports and accounts of progress. But along with this autonomy, indispensable to the highest efficiency in such organizations, it is equally essential that there should coexist a fraternity of interest and a solidarity of purpose centering in the institution as a whole. First steps toward development of these latter desiderata were taken in December, 1909, on the occasion of the annual meeting of the board of trustees, when the administration building was dedicated and when the directors of departments of research were invited to give exhibits of the salient features of their work up to that time. On the same occasion two related experiments were inaugurated, namely, that of a lecture to the trustees and their guests from the head of a department of research, and that of a conference between the directors of departments and the president. The results of these experiments have been so favorable that the plan of having an annual lecture, an annual conference, and exhibits of departmental work at intervals of three to five years, has come to be adopted by common consent. In addition to the exhibit held in December, 1909, another was held in December, 1911, on the occasion of the tenth anniversary of the foundation of the institution.

By reason of the decision of the board of trustees a year ago to take part in the Panama-Pacific Exposition, to begin in San Francisco in February, 1915, it is proposed to hold the next departmental exhibit in the administration building at the time of the meeting of the board of trustees in December, 1914. It will thus be practicable to bring together an aggregate from which (by aid of counsel from departmental representatives) a more restricted exhibit may be drawn for the Panama-Pacific Exposition. On account of this circumstance and on account of the fact that the departments on the average, as well as the present administration, will have completed a first decade in the institution's history a year hence, it seems desirable to reserve any more elaborate summaries of work accomplished and now under way, whether of departments or of research associates, until that time. Accordingly this section of the present report is limited to something less than the usual extent.

DEPARTMENT OF BOTANICAL RESEARCH

Studies of the Salton Sea,[2] carried on

[2] Often by earlier writers called Cahuilla Basin, more frequently called Salton Sink, and now

during the past seven years by this department in collaboration with a number of contributing specialists, have been brought together during the year in a volume now in press under the title "The Salton Sea: A Study of the Geography, the Geology, the Floristics and the Ecology of a Desert Basin," as publication No. 193. A great number of interesting questions in geography, geology, botany, chemistry, microbiology, plant physiology, climatology, etc., are discussed in this volume. Of these, an instructive abstract is given by the director in his current report.

Among many researches carried on by the director, mention may be made of his cultivation of second and third generations of mutants arising from ovarial treatments of plants and resulting in further noteworthy morphological and physiological departures from the original parent stocks. Of members of the departmental staff, Dr. Cannon has extended his fruitful studies of root systems of desert plants to include the corresponding characteristics of trees in the coastal climate of California and to the problem of treelessness in prairie regions. Dr. Forrest Shreve has given special attention to the factors involved in the transpiration of rain-forest plants and to the effects of mountain slopes and climatic conditions varying with altitudes and with exposures. Dr. Spoehr has continued his investigations of the action of light and heat in producing chemical changes in plant organisms, giving promise thus of important advances in the newer field of phytochemistry and photolysis

Several collaborators have contributed to the varied work of the department during the year. Sections of the director's report are thus devoted to accounts of the further experiments of Professor W. L. Tower on the evolution of chrysomelid beetles, for which facilities are provided at the Desert Laboratory; to the physical studies of Professor B. E. Livingston, formerly a member of the departmental staff, on the water relations of plants; to the determinations of autonomic movements in opuntias by Mrs. Shreve, whose volume on "The Daily March of Transpiration in a Desert Perennial" is in press as publication No. 194; to the investigation of Professor H. M. Richards on the acidity, the gaseous interchange and the respiration of cacti; to the surprising properties of the opuntias in fruit development, brought to light by Professor D. S. Johnson; and to the favorably progressing enterprise undertaken by the department, in collaboration with Dr. N. L. Britton and Dr. J. N. Rose, for a systematic determination of the distribution and relationships of the cactus family of plants.

called Blake Sea, in honor of Professor Blake, who, as geologist of the Williamson survey of 1853, first accurately interpreted this remarkable depression below sea-level.

DEPARTMENT OF EXPERIMENTAL EVOLUTION

The work of the year in this department records, among many other advances, additional contributions to the laws of human inheritance; the results of further and more conclusive studies of the transmission of traits in plants of the genera *Bursa* and *Œnothera;* and some preliminary indications of specially instructive investigations in the field of biochemistry. The director has divided his time between researches based on breeding experiments carried on at his station and studies of data bearing on human heredity collected under the auspices of the Eugenics Record Office, of which he is also the directing head. In addition to the researches carried on by Doctors Banta, Gortner, Harris and Shull of the resident staff, Dr. A. F. Blakeslee, Dr. G. C. Bassett and Professor John H.

Gerould have pursued investigations in collaboration with this staff. One of the most important of these cooperative enterprises is the joint investigation of Dr. Blakeslee and Dr. Gortner on the low organisms called mucors, from which it appears that sex-differentiation in these organisms has a determinate physical basis. This conclusion appears to bear a close relation to similar fundamental conclusions reached independently in other lines of work by our research associates, Dr. Reichert and Dr. Osborne.

The exigencies of his experimental work going forward at the departmental station have prevented Dr. Shull from completing the manuscript of his account of the work of Luther Burbank. It has been arranged, therefore, that he shall spend some months abroad, beginning with October, 1913, in order that uninterrupted attention to this manuscript may enable him to finish it without undue delay. The importance of the biochemical laboratory, in charge of Dr. Gortner in connection with the department, has been well attested during the year by the aid he has rendered in the complex studies evidently essential to further advances in the problems of plant and animal evolution. The more adequate provision for this laboratory adjunct furnished by the new departmental buildings, already referred to, will make it practicable to utilize still more advantageously the highly developed qualitative and quantitative methods and data of the older science of chemistry.

DEPARTMENT OF ECONOMICS AND SOCIOLOGY

Substantial progress toward completion of the several contributions from the twelve divisions of this department to their projected basis for a social and economic history of the United States is reported by Professor Henry W. Farnam, chairman of the department. It is estimated by him that six of the divisions will be able to present final reports within the next fiscal year. These are the divisions of population and immigration, in charge of Professor Willcox; mining, in charge of Mr. Parker; transportation, in charge of Professor Meyer; domestic and foreign commerce, in charge of Professor Johnson; labor movement, in charge of Professor Commons, and social legislation, in charge of the chairman. Delays due to the requirements of their primary occupations, to ill health or misfortune in the case of some collaborators, and to demands of public service in other cases, have prevented the remaining divisions from bringing their work to a similarly forward state.

The chairman again calls attention in his report to the desirability of reorganizing this department and placing it on a basis similar to that of all other departments of research of the institution. As to the appropriateness of this recommendation, there now appears to be no dissent, either within or outside the department. It is hoped, therefore, that such a reorganization may be consummated as soon as the work now in hand may be completed in accord with the original plan, if it should not appear advantageous to make the obviously desirable change at an earlier date. There is no doubt that the field of opportunity for effective pioneer work by such a department is in great need of present-day cultivation and that it extends indefinitely into the future.

THE GEOPHYSICAL LABORATORY

The preliminary stages in the development of this hitherto unique establishment may now be said to have passed, since laboratories similarly equipped and for like purposes are now being set up under other auspices. That the merits of the methods,

the apparatus and the earlier published researches of the geophysical laboratory should have been thus early recognized is at once a source of gratification to the institution and an additional stimulus to fundamental work in the difficult but ever fruitful domain of geophysics. In his annual report the director gives instructive accounts of the effects of pressure in the formation of minerals, of progress in the perfection of adequate appliances for calorimetric measures of minerals, of the factor of temperature in optical studies of crystals, of the results thus far obtained in volcano studies, and of the important economic investigations (now under way at the laboratory) of the secondary enrichment of copper sulphide ores. It had been hoped that the signal success attending the studies of Kilauea a year ago might be followed up during the past year, but in this the staff has met disappointment, for the volcano has been inactive and gives no warning of renewed opportunities.

The activities and productivities of the laboratory staff are indicated impressively by the 52 papers issued during the year, or now in press, reviewed in the report of the director. These have been, or will be, published in current journals. Several of them appear as duplicates by reason of translations into the French or the German languages; of these, it is interesting to note that a translation into French by Professor P. Chappuis has been made (for the *Journal de Physique*) of the work of Day and Sosman on "High Temperature Gas Thermometry," publication No. 157 of the Institution.

DEPARTMENT OF HISTORICAL RESEARCH

The purposes to which this department is devoted and the programs it proposes to follow have been outlined in the director's annual reports of the past seven years. He took occasion also, in December a year ago, when he gave the annual trustees' lecture, entitled "The Future Uses of History," to present a fuller statement of these purposes and programs, as well as to indicate the rôle which history may fittingly play in the evolution of the social organizations which must occupy the attention of our successors. This instructive lecture was rendered available to a wider circle of interested students of history by publication in *The History Teachers' Magazine* for February, 1913.

Briefly stated, the main purposes of the department are two: first, to furnish aids, guides and reports which may give appropriate direction to the writers of monographs and general histories; and, secondly, to furnish full textual publication of important historical documents. Under the first of these heads the director reports very favorable progress toward completion of a series of three guides to the materials for American history in London archives and in the libraries of Oxford and Cambridge universities. The first volume of this series was issued as No. 90 of the institution's publications in 1908, and the other two volumes, now nearly through the press, are designated 90A and 90B, respectively. As to this series the director remarks in effect in his report that no similar inventory of like extent, concerning archive materials which London possesses for the history of any other nation, has ever been issued. Two additional volumes in this first division of activities have appeared during the year, namely, publication No. 163, "Guide to Materials for United States History in Mexican Archives," by Herbert E. Bolton; and publication No. 172, "Guide to Materials for United States History in Canadian Archives," by David W. Parker. Under this head also progress is reported in the work of Mr. Leland on

materials for American history in Paris archives, in the work of Professor Hill in Spanish archives, and in the corresponding work of Professor Faust in Switzerland and in Austria. Under the head of textual documents the director refers in some detail to progress in the preparation of the projected collections of "Letters of Delegates to the Continental Congress," of "European Treaties Bearing on United States History," of "Proceedings and Debates of Parliament Respecting North America, 1585 to 1783," and to a preliminary report on papers of the Royal African Company in the Public Records Office of London.

Attention is especially invited to the director's interesting review of the work of the department during the first decade of its existence, completed with this fiscal year. Some idea of the extent of this work may be gained from the list of departmental publications cited, the number of these being 17, with an aggregate of over 5,000 pages; while the bulky correspondence of the institution as a whole is in some degree indicated by the fact that this department records an aggregate of upwards of 20,000 letters in its decennial inventory.

DEPARTMENT OF MARINE BIOLOGY

When the laboratory of this department was established on Loggerhead Key, Dry Tortugas, Florida, now nearly ten years ago, Fort Jefferson, on an adjacent island, was an important base station of the United States navy and transportation to and from points on the Gulf coast was a matter of daily occurrence. In the meantime, however, this station has steadily diminished in importance and is now virtually abandoned as a naval base. This change of conditions shifts the burden of transportation between the laboratory and the nearest port, Key West, about thirty miles distant, wholly upon the department; and the resulting increased cost and inconvenience have led the director to recommend a gradual transfer of his laboratory and activities to a more favorable site. Preliminary investigations indicate that such a site may be had in Jamaica, where health conditions and transportation facilities have been much improved in recent years, where the cost of labor and subsistence is low, and where such an international scope as best benefits marine biology could be readily developed. It may be anticipated that definite plans for an advantageous change of site will be matured during the coming year and ready for submission to the board of trustees in December, 1914.

The department has suffered serious loss during the year in the untimely death of a remarkably able research associate, George Harold Drew. It has met with a reverse also in the temporary illness of another research associate, Dr. T. Wayland Vaughan. Drew and Vaughan had under way important investigations, originating at Tortugas, for the furtherance of which the departmental expedition of this year to Torres Straits was largely planned and authorized. Drew had made the discovery at Tortugas that the so-called coral mud in that vicinity is not due to corals, but has been precipitated through the chemical agency of a bacillus abundant in the surface waters of the tropical Atlantic. Vaughan, on the other hand, had made quantitative studies of the growths of coral organisms at Tortugas and of the closely correlated deposits or reefs. Jointly their investigations promised a solution of the long-vexed problem of the origin of such reefs and it was hoped that the expedition to Torres Straits and Great Barrier Reef would enable them to secure the additional data essential to final proof. In spite of

these adversities, however, the director and four associates sailed from San Francisco for Sidney, Australia, on July 23, 1913, and arrived at Torres Straits early in September. When last heard from, in September, the party was reported all well on Murray Island.

The laboratory season at Tortugas extended from April to June, inclusive, and twelve collaborators availed themselves of the facilities afforded for their researches. Summaries of these are given by the director in his current report, while more elaborate accounts are furnished by the investigators themselves in appendices to that report. Two additional volumes of contributions from the Tortugas laboratory are in press as publications Nos. 182 and 183.

DEPARTMENT OF MERIDIAN ASTROMETRY

On the death, October 5, 1912, of Professor Lewis Boss, director of this department since its establishment in 1906, his son, Mr. Benjamin Boss, long associated with his father in meridian astrometry, was made acting director. Adherence to the original program, so indispensable to the formidable enterprise this department has under way, is thus assured. The extensive computations essential in the derivation of the great number of stellar positions observed at the temporary observatory at San Luis, Argentina, are going forward at a favorable rate, so that the inclusive catalogue of precise positions for stars in both hemispheres may be expected in due time. Some instructive results of these computations, showing the stability of the San Luis meridian mark (mire), the diurnal variation of the clock corrections, and the changes of personal equation for day and night observations are given in the report of the acting director.

As in most lines of fruitful research, the work of this department is noteworthy for its by-products, or for contributions it is making to allied lines of inquiry. Obviously, a first requisite to a knowledge of stellar motions lies in precise determinations of stellar positions at different epochs. The so-called proper motions of stars are thus brought to light, and from these it is possible to determine also the motion of our solar system. But now comes the surprising discovery that these proper motions, hitherto supposed to be of a random character, are of a systematic nature dependent in large degree, apparently, on the stage in evolution any individual star has reached and on the group to which it belongs. A new and peculiarly fascinating field is thus opened to astronomers of all kinds, and the by-products referred to seem destined to prove not less important than its primary object in positional astronomy. The world of astronomy, however, is anxiously awaiting the attainment of this object, as is well shown by the fact that the preliminary catalogue issued by the department three years ago is already out of print.

THE NUTRITION LABORATORY

One of the reasons which helped seven years ago to determine the location of this laboratory was found in the expectation that several hospitals would be erected in the near vicinity. This expectation has now been realized by the completion during the past year of the Peter Bent Brigham Hospital, the Collis P. Huntington Memorial Hospital, and of two hospitals for infants and children respectively. The environment and the opportunities for securing pathological subjects as well as clinical cooperation and counsel are therefore highly favorable for the researches undertaken by this establishment. That it has entered a fruitful field of activity is well attested by the wide interest shown in

its publications already issued, by the desires of experts at home and abroad to learn of the ways and means employed, and by the duplication in laboratories of other countries, as well as in those of America, of apparatus developed.

But science is cosmopolitan, and although many novel enterprises may be said to have originated with the institution, it may not lay claim to any monopoly in research; it can only contribute here and there in a limited degree to the ever-expanding aggregate of verifiable knowledge. In recognition of these limitations the director has appropriately adopted the plan of inspecting, at frequent intervals, the laboratories, the special apparatus and the technique developed elsewhere for the same and allied work. Thus he has made during the past year a third triennial tour of European laboratories, hospitals, etc., devoted to such work. This has afforded opportunity for numerous advantageous conferences with colleagues and for the selection of new apparatus of proved utility; while the director has been able during the same time to give counsel in respect to the adoption in other laboratories of apparatus and methods similar to those of the nutrition laboratory. The latter, therefore, like the geophysical laboratory, is no longer distinguished by its singularity, but must now enter upon a career of friendly rivalry with many cognate establishments.

For details of the investigations of the year, reference must be made to the director's report. They are summarized by him under thirteen principal heads, which range from studies of metabolism in infants, through those of normal metabolism in adults, up to studies of chronic starvation and diabetes mellitus. Many publications issued or in press during the year are also reviewed by the director in his report. Considerable new apparatus has been acquired and earlier forms of equipment have undergone modifications suggested by experience. Interesting mention is made of visiting and cooperating investigators, of the special researches of the laboratory staff, and of the conferences had by the director during his trip abroad. The staff has been enlarged during the year by the addition of Professor Raymond Dodge, who will undertake work in the psychology of nutrition, and by Mr. E. H. Lange, who will serve as physicist for the staff.

Department of Terrestrial Magnetism

As already indicated in an earlier section of this report, one of the noteworthy events of the year for this department will be the completion of the second cruise of the non-magnetic ship *Carnegie*. She is now on the last stretch of this cruise and may be expected to arrive at a home port before the end of the calendar year, having been continually in service since June 20, 1910. The aggregate distance traversed in her two cruises will be in round numbers 80,000 miles. The corresponding distance covered by the chartered ship *Galilee*, in the Pacific Ocean during 1905–08, is 60,000 miles. Thus the total distance traversed up to date in the magnetic survey of the oceans is 140,000 miles, or about six times the circumference of the earth. Accurate magnetic data have been obtained thereby in all of the oceans between the parallels of 50° north and 50° south latitude, or near the courses usually followed by vessels. By reason of the expedition attained in deriving from these surveys the results of chief interest to mariners, it has been practicable for chart-publishing establishments to make prompt revision of defective sailing charts or to issue corrections thereto; and a distinct improvement in these aids to navigation is already noticeable in the charts issued by the leading maritime nations. The

more complete results of these ocean surveys are also in a forward state of preparation and it is expected that a full account of the work accomplished by the *Galilee* and the *Carnegie* will be ready for publication a year henee. In the near future it is considered that the *Carnegie* should make surveys in areas not yet covered and along some stretches already traversed where cloudy or stormy conditions have prevented the securing of adequate observations. She will at the same time cross her previous tracks as often as practicable in order to determine for such intersections the information now most needed by chart-makers, namely, the annual changes in the magnetic elements.

Magnetic surveys of land areas are also proceeding at a favorable rate. An expedition under Mr. D. W. Berky, assisted by Mr. H. E. Sawyer, has traversed the Sahara Desert, starting from Algiers near the end of October, 1912, and arriving at Timbuktoo May 12, 1913; and these observers are now extending their work into the territory of west and central Africa bordering on the Atlantic. Dr. H. M. W. Edmonds has led an expedition into Canada, west of Hudson Bay, near the location of one of the supposed poles of the earth's magnetic field. Mr. A. D. Power has made noteworthy progress in a survey of northeastern South America, including a trip along the Orinoco River and the Rio Negro from the mouth of the Orinoco to Manaos on the Amazon. Mr. H. F. Johnston is engaged in a series of determinations along a line running northward from Montevideo towards Manaos. Similarly, the magnetic survey of Australia and the adjacent islands is making efficient progress under the immediate charge of Mr. E. Kidson. Under his guidance Mr. E. K. Webb was trained for and supplied with instruments for the valuable magnetic work accomplished by the Mawson Antarctic expedition.

In the near future it is anticipated that the department will have sufficient data to permit the construction of a new set of magnetic charts, including all three magnetic elements (declination, dip and intensity), especially for that part of the globe included between the parallels of 50° north and 50° south of the equator. It will then be practicable to study the general problem of the earth's magnetism by aid of a large mass of homogeneous data surpassing in definiteness any mass hitherto available for this purpose. In anticipation of the need of experimental facilities for studies of this problem and others closely related thereto the office and laboratory building of the department was authorized a year ago and is now approaching completion, as explained in a previous section of this report. For the conduct of experimental researches the department has been fortunate in securing the services of Dr. W. F. G. Swann, late of the University of Sheffield. Mr. Charles R. Duvall, late of the U. S. Coast and Geodetic Survey, has also recently joined the office staff to fill the position of chief computer.

Attention is invited to the director's remarks on the present status of the department's work, to the account of his own researches of the year, and to his programs for further work. And in the interests of further possible work of construction of buildings under the auspices of the institution, it may be worthy of note that preliminary plans for the new laboratory were well matured by Mr. Fleming, engineer of the departmental staff, before consulting an architect, and that supervision of construction has also been assigned to Mr. Fleming. This method of procedure, which has been followed in several instances by the institution, appears to be highly advantageous for economy and for efficiency.

THE SOLAR OBSERVATORY

From the date of its establishment nine years ago this observatory has been one of the most important of the enterprises fostered by the institution. It has called for heavy annual appropriations; it has grown with extraordinary rapidity and with equally extraordinary productivity; and it is now an organization whose staff of investigators, research associates and collaborators, constructors, computers, designers, mechanicians and operators includes upwards of sixty individuals. By reason of the widespread popular and technical attention given to astronomical science, and by reason of the novel equipment of this observatory and the relatively new field entered by it, the world looks with special interest on its development, quite apart from the keen general interest in the contributions it has made and may be expected to make to astrophysics. This special interest centers in the fact that the experience of the observatory furnishes the details of an experiment on a large scale in a difficult field of inquiry, for which ways and means of corresponding magnitudes have been available. In general the means at hand for such enterprises have been incommensurate with the obstacles to be overcome, and progress has been hindered, delayed or blocked until necessity has devised some indirect way of surmounting these obstacles. But, on the other hand, this necessity has hitherto exerted a highly beneficial influence in stimulating discovery and invention, and one may perhaps question whether in the past ampler means for the pursuit of systematic research would have been on the whole advantageous for the advancement of knowledge. Some eminent authorities, indeed, still question the propriety of the endowment of research in any but educational establishments. Contemplative minds are therefore awaiting the results of the experiment of the solar observatory with an eagerness only exceeded by that of the popular mind for information concerning the latest discoveries and advances in astronomical science.

In the meantime, with the installation of additional equipment and the application of appropriate methods of research, the observatory is increasingly productive. The principal results of the work of the past year are summarized by the director in his current report under seventy-two heads. No further summary of these results may be attempted here; attention may be given to a few only of the salient items of interest suggested by the report as a whole. The year has been one of minimum solar activity and noteworthy for a nearly complete absence of sun-spots. This has proved advantageous for the pursuit of studies of the sun's magnetism now definitely proved by work done at the observatory during the year. This advance in solar physics is of the highest interest by reason of its probable relations to terrestrial magnetism and to cosmic physics. Stellar and laboratory work have gone forward at a highly productive rate, and the subjects of solar, stellar and laboratory spectra and stellar velocities are among those instructively considered in the director's report. Evidence has been accumulated tending to show that light is absorbed in space, and that such a phenomenon will not only elucidate others hitherto obscure, but furnish means of measuring the greater depths of the visible universe. Professor Kapteyn has continued to act as research associate and adviser in the program of researches undertaken. The important results attained by Professor Störmer, who spent some time at the observatory as a research associate in 1912, in his investigation of solar vortices, and

those of other collaborators and members of the observatory staff, present features of special interest in the departmental report.

Favorable progress has been made in grinding the glass disk for the 100-inch telescope since the source of the obstacle encountered in this work was discovered about a year ago. The disk has been subjected to severely critical tests, which give assurances that it will meet requirements. The preparation of a 60-inch plane mirror for testing the 100-inch reflector has gone on simultaneously with work on the latter. The heavier parts of the mountings for the telescope are now under construction by the Fore River ship yards at Quincy, Massachusetts, while the foundations on Mount Wilson and the dome superstructure will probably be completed as soon as the disk and its mountings are ready. Allusion has already been made in a previous section to the new office building at Pasadena and to the remarkable success achieved in the construction of a dividing engine for ruling diffraction gratings. For adequate accounts of these and numerous other subjects of interest reference must be made to the director's full report.

WORK OF RESEARCH ASSOCIATES AND COLLABORATORS

As indicated in previous reports, the complexity of the relations which research associates and collaborators sustain to the institution is so great as to preclude any comprehensive explanation within the limits allotted to an annual administrative report. Their work embraces a wide range of subjects and varies in its conduct from individual independence to intimate collaboration with the departments of research and with the division of publications. During the past year more than twenty distinct fields of research have been cultivated and a total of more than one hundred investigators have contributed to the output. Summaries of the work of associates proceeding independently are given by them in the current year book. Their publications of the year are cited in the bibliographical lists of later sections, and the work of many collaborators is mentioned in departmental reports. Attention may be called, among many important researches, to that of Professor H. N. Morse on the osmotic pressure of solutions, now approaching completion; to the investigations of Professor Mall and colleagues in embryology; to the completion of the edition of the Arthurian Romances by Dr. H. Oskar Sommer by the publication during the year of the seventh volume of this monumental contribution to early English literature; to the appearance during the year of a translation into German of the work on "Dynamic Meteorology and Hydrography," the institution's publication No. 88, by Professor V. Bjerknes; to the significant studies of Professors Osborne and Mendel in extension of their researches on the vegetable proteids; to the fundamental investigations of Professor Reichert, brought out in publications Nos. 116 and 173; and to the penetrating contributions to philology embodied in the series of researches of Mr. William Churchill, published in Nos. 134, 154, 174 and 184.

FINANCIAL STATEMENT FOR FISCAL YEAR 1912–1913

The sources of funds available for expenditure during the past fiscal year, the allotments for the year, the revertments made during the year, and the balances unalloted and unexpended at the end of the year are shown in detail in the following statement:

Object of Appropriation	Balances Unalloted Oct. 31, 1912	Appropriation Dec. 13, 1912	Revertments Nov. 1, 1912, to Oct. 31, 1913	Total	Aggregates of Allotments and Amounts Expended and Transferred	Balances Unalloted Oct. 31, 1913
Large grants	.....	$816,972	$21,287.75	$838,259.75	$838,259.75	.....
Minor grants	$6,213.49	116,800	8,229.48	131,242.97	125,980.41	$5,262.56
Publications	16,881.18	60,000	5,315.33	82,196.51	66,693.30	15,503.21
Administration	.....	50,000	5,000.00	55,000.00	55,000.00	.....
Reserve fund	.....	250,000	.....	250,000.00	250,000.00	.....
Insurance fund	.....	25,000	.....	25,000.00	25,000.00	.....
Total	23,094.67	1,318,772	39,832.56	1,381,699.23	1,360,933.46	20,765.77

The following list shows the departments of investigation to which the larger grants were made by the trustees at their last annual meeting and the amounts alloted from these grants by the executive committee during the year:

Department of Botanical Research	$38,005.00
Department of Experimental Evolution	95,141.75
Geophysical Laboratory	78,000.00
Department of Historical Research	29,600.00
Department of Marine Biology	31,890.00
Department of Meridian Astrometry	25,180.00
Nutrition Laboratory	46,549.00
Division of Publications (office expenses)	9,000.00
Solar Observatory	165,631.00
Department of Terrestrial Magnetism	210,263.00
Researches in Anthropology	7,000.00
Researches in Embryology	15,000,00
	$751,259.75

The fields of investigation to which minor grants were assigned, the names of the grantees, and the amounts of the grants are shown in the following list:

Field of Investigation	Names of Grantees	Amounts of Grants
Astronomy	Kapteyn, J. C.	$2,000.00
Archeology	Bandelier, Adolf F.	2,000.00
	Van Deman, E. B.	1,800.00
Bibliography	Index Medicus	12,500.00
Biology	Riddle, Oscar	5,600.00
	Watson, John B.	500.00
Botany	Britton, N. L., and J. N. Rose	6,900.00
Chemistry	Acree, S. F.	2,000.00
	Baxter, G. P.	1,500.00
	Osborne, T. B., and L. B. Mendel	15,000.00
	Jones, H. C.	3,200.00
	Morse, H. N.	4,000.00
	Noyes, A. A.	3,000.00
	Richards, T. W.	3,000.00
	Sherman, H. C.	1,200.00
Geology	Chamberlin, T. C.	4,000.00
	Moulton, F. R.	2,000.00
History	Osgood, H. L.	1,200.00
Literature	Bergen, Henry	1,800.00
Marine Biology	Drew, G. Harold	2,000.00
	Vaughan, T. Wayland	3,300.00
Mathematics	Morley, Frank	1,200.00
Metallurgy	Howe, Henry M.	500.00
Meteorology	Bjerknes, V.	1,800.00
Nutrition	Tigerstedt, Carl	1,000.00
Paleontology	Case, E. C.	2,000.00
	Hay, O. P.	3,000.00
	Wieland, G. R.	3,000.00
Paleography	Loew, Elias A.	1,800.00
Physics	Hayford, J. F.	2,000.00
	Nichols, E. L.	3,000.00
	Barus, Carl	500.00
Physiology	Cooke, Elizabeth	1,900.00
	Reichert, E. T.	1,500.00
Zoology	Castle, W. E.	1,000.00
	Naples Zoological Station	1,000.00
Administration Building (additions)		5,792.66
Reception, National Acad of Sciences		1,000.00
International Phytogeographical Association		1,200.00
		$111,692.66

The following grants for publication were authorized during the year:

Andrews, C. M.	$2,006.22
Barus, Carl	900.00
Benedict, F. G., and E. P. Cathcart	2,200.00
Bergen, Henry	170.00
Cannon, W. A.	2,000.00
Case, E. C., S. W. Williston, and M. G. Mehl	1,200.00
Castle, W. E., and C. C. Little	2,100.00
Castle, W. E., and J. C. Phillips	650.00
Davenport, C. B.	800.00
Churchill, William, and J. P. Finley	2,000.00
Huntington, E.	3,800.00
Index of U. S. Documents relating to	

Foreign Affairs	12,000.00
Jones, H. C.	1,400.00
Jones, H. C.	1,500.00
MacDowell, E. C., and W. E. Castle	600.00
MacDougal, D. T., *et al.*	4,200.00
Osgood, C. G.	9,000.00
Papers from the Tortugas Laboratory	3,800.00
Reichert, E. T.	1,094.68
Shreve, Edith B.	700.00
Smith, E. F.	4,800.00
Sommer, H. O.	6,500.00
Walcott, C. D.	272.40
Weed, L. H.	1,600.00
Wright, Albert Hazen	1,400.00
	$66,693.30

The sources and amounts of the revertments from November 1, 1912, to October 31, 1913, inclusive, are shown in the following list:

Large grants:		
Transferred from minor grants	$3,287.75	
Revertment, Division of Publications	3,000.00	
Revertment, Department of Meridian Astrometry	15,000.00	
		$21,287.75
Minor grants:		
Cooke, Elizabeth, Grant No. 878	550.00	
Drew, G. Harold, Grant No. 854	2,000.00	
Fitting, Hans, Grant No. 816.	1,800.00	
Historical Research, Department of, Grant No. 794	90.00	
Osborne, T. B., Grant No. 692	83.32	
Reception, National Academy of Sciences, Grant No. 879.	381.16	
Terrestrial Magnetism, Department of, Grant No. 798	25.00	
Vaughan, T. Wayland, Grant No. 855	3,300.00	
		8,229.48
Publication:		
Barus, Carl, Grant No. 872.	353.50	
Benedict and Jones, Grant No. 820	284.00	
Bergen, Henry, Grant No. 826	7.13	
Burnham, S. W., Grant No. 803	884.15	
Callaway, Morgan, Jr., Grant No. 802	11.00	
Cannon, W. A., Grant No. 824	531.70	
Carnegie Institution of Washington, Grant No. 667	218.73	
Churchill, William, Grant No. 801	851.08	
Farlow, W. G., Grant No. 63.	365.00	
Jones, Harry C., Grant No. 819	33.05	
Lancaster, H. C., Grant No. 814	309.70	
Loeb, Leo, Grant No. 821	323.06	
Researches of the Department of Terrestrial Magnetism, Grant No. 818	1,143.23	
		5,315.33
Administration:		
Revertment from allotted balance		5,000.00
		$39,832.56

R. S. WOODWARD

EDUCATIONAL INTERESTS AT WASHINGTON

I

ONE of my first impressions when I joined the Federal Bureau of Education at Washington, in the summer of 1906, was that of the cooperative friendliness of the various executive offices with which I had to do. Every door was open. My newfound colleagues in the Department of the Interior and its other bureaus, the higher officials of three or four other departments, with whom the business of my office soon brought me into contact, the public printer, the civil-service commissioners, the director of the census, officials of the Smithsonian Institution, the librarian of Congress, the White House staff, and the President himself—all were not only easy of access, but were prompt to welcome the newcomer and to lend him a helping hand.

On the day that I entered upon my new duties, the thermometer in my office registered 95°. The rest of the summer was steaming hot. It rained on St. Swithin's day and—more or less—for forty days thereafter, and the sticky heat was well-nigh unbearable. But the warmth of welcome which I experienced at the hands of members of the administration who were still on duty at the Capital did much to make that external heat and humidity endurable.

I began, indeed, to wonder whether the difficulties of which I had been warned were not imaginary. Here was none of that immobility of the great governmental machine of which I had heard so much. It was not until the eve of the assembling of Congress that the other side of the picture was fairly exposed. On Thanksgiving Day I was summoned before the House Committee's sub-committee on the "legislative" appropriation bill, for my first annual hearing on the estimates for the bureau for the next ensuing fiscal year. Then I knew. No great advance could be made in the usefulness of the education office without increase of appropriations; and there was evidently in Congress an intrenched tradition that the federal government should not go deeply into expenditures for public education.

In order to be quite fair, some qualifications must, of course, be made. The contrast in attitude between the executive and the legislative branch of the government was not that between white and black but that between light gray and a misty dimness.

Not everything was easy on the administrative side. There were some difficulties that were internal to the bureau. Such were, of course, inevitable. They were, however, made good in part by the loyal support of competent men and women on the staff of the office.

I may go out of my way just here to pay tribute to my venerated predecessor in the commissionership, Dr. William T. Harris. He had presided over the Bureau of Education so long, and with so dominating a personality, that in a sense it had become his own. He continued his residence in the city of Washington. He was a veritable mine of information and judgment regarding the bureau in all of its relationships. Yet from the moment that he laid down his official responsibility, he did not seek in any particular to direct or even to influence the administration of his successor, while giving at all times a friendly sympathy and support that was, to the younger man, of immeasurable value.

Secretary Ethan Allen Hitchcock was at the head of the Department of the Interior. I soon found some justification for the saying that he counted every man guilty till he should have proved himself innocent. The delicate question here was the management by the bureau of the reindeer annex to its provision for the education of the Alaskan natives. This branch of the service was in a peculiarly perplexing situation just then. When President Roosevelt had called me to Washington, to offer me the post of commissioner, his talk had hardly touched upon any other side of the bureau's activity. While the secretary's attitude on this subject for a time increased the difficulty of the situation, and a solution was not reached until he had been succeeded in the portfolio by Mr. Garfield, I entertained, nevertheless, and still retain, something like historic veneration for the really Roman personality and service of Secretary Hitchcock.

One of my earliest attempts to widen the service rendered by the education office brought me into interesting relations with an assistant secretary. He was the acting head of the department during the temporary absence of his chief. What I sought

to do was to publish a bulletin of miscellaneous educational information, to be put forth in occasional issues, as matter of practical value should become available. When I broached this plan to my associates in the bureau, one of them, having a long memory, called my attention to an obscure clause in an Act of Congress already ten years old, which expressly provided for such a publication. This was encouraging. But there was no appropriation to cover the cost of printing. As in the case of other miscellaneous printing for this office, an allotment must be secured from a general appropriation for printing in the Department of the Interior, and that was under the secretary's immediate control.

I laid the case before the acting secretary, calling his attention to the fact that the proposed publication had already been authorized by Congress, and also that it would enable the bureau to discharge more effectively one of the chief functions assigned to it in the Act for its establishment, namely, that of distributing educational information. He had himself been a member of Congress. He listened to my statement most courteously, and then replied that the thing could not be done. The money was needed for other uses.

There was, fortunately, present at the interview one of the indispensable men of the department. A fair number of such men are to be found distributed through the several branches of the government—men of sane judgment, possessed of unlimited and accurate information, devoted to the interests which their several offices serve, and free from that form of ambition which would prompt them to intrigue for their own advancement. There is no reason why I should not make individual mention of Mr. W. B. Acker, to whom I have referred. I doubt not he is still serving the public from that piled-up desk of his; and I hope the public will long enjoy and appreciate his services.

I had already consulted him with reference to my little publication plan. The acting secretary glanced toward his subordinate when pronouncing his adverse decision. Most tactfully then the under official reminded the high official that the very modest sum required could be spared without appreciable detriment to any other interest, and that the legality of such use of the fund was beyond question. With only two or three sentences, the scale was turned. The expenditure was approved, and the preparation of the first issue of the bulletin was immediately begun.

I believe the publication has been a useful one from the start, and it is now having a great development at the hands of Commissioner Claxton.

A few such experiences as that described above led me to the all-too-hasty generalization that if a public official desired to do anything new in Washington, he would either find that it is already in the law of the land, or that it is impossible—and sometimes both at once.

With other assistant secretaries, and indeed with the one referred to above, I had other relations in plenty which I can recall only with warm appreciation and gratitude.

But to come back to the legislative side of the matter. Here, again, I must avoid too sweeping a statement. In the matter of appropriations, I fared as well as my predecessors or perhaps a little better. Including the provision for the Alaska work, the appropriations were increased in those five years by about 68 per cent. This would not be so bad a showing, were it not that the total amount was pitifully small as compared with the magnitude of the interests and needs involved. For the year 1911–1912, the appropriation for the

Alaska work was $212,000, and for all of the rest of the activities of the bureau only $79,800, to which there should be added an allotment from the secretary's fund for printing amounting to $50,000.

I was early impressed with the fact that it was easier to get appropriations for the education of the natives of Alaska than for the bureau's ordinary work of collecting and diffusing information. At the first session of Congress after I had entered the bureau, through the active interest of Mr. Tawney, then chairman of the House Committee on Appropriations, there was procured an addition of $100,000 to the annual appropriation for the Alaska work. On the other hand, even small additions to the provision for collecting educational information, for the employment of competent experts in different branches of education, and so on, were secured only with the greatest difficulty.

II

It would seem, indeed, to be a fixed tradition in both Houses of Congress that the expansion of the education office shall be only gradual and comparatively insignificant. It has been shown, on the other hand, that at some time or other a rapid and considerable expansion will have to take place in order to bring up arrears, as it were, and enable the office to "start even" with its responsibilities. But that time is not yet in sight.

When one secretary of the interior made an active effort to secure increased appropriations, he was turned aside with the intimation that further legislation was necessary as a basis for such appropriations; and when this suggestion had been followed up and existing statutes had been found to cover the case completely, the session was too far advanced to secure the desired additions to the appropriation bill of that year. President Roosevelt in his last annual message recommended a substantial increase, but without result. The National Education Association passed its resolutions, and made its personal representations through a strong committee, headed by President John W. Cook, of Illinois. Some three or four years ago a wide campaign, in which the Russell Sage Foundation bore an important part, was carried on with the purpose of arousing public interest and awakening in Congress a more serious attention to the needs of the bureau. Mr. Herbert Parsons seconded this effort with an able address on the floor of the House. The result was that there was granted about one tenth of what had been sought.

There are doubtless reasons for this comparative inaction on the part of the Congress. I shall not undertake to canvass them here. But a word may be said concerning one objection frequently heard, namely, that education belongs to the states, and lies outside of the proper sphere of the federal government. It does not appear that any such objection lies against the main activity of the Bureau of Education, which is not that of educational administration at all, but that of disseminating useful information. The objection, moreover, can hardly be taken seriously as against activities which have been maintained by Congress for nearly fifty years. Each renewal of its appropriations for such activities has been a fresh assertion of the right to carry them on, and each small increase of those appropriations has laid new emphasis upon that assertion.

A comparison of the history of the Department of Agriculture with that of the Bureau of Education is instructive. Both of these offices have to do with interests which some would regard as falling within the range of the state governments, rather

than within that of the federal government. Both of them are concerned chiefly with the spread of information rather than with administrative control. Both came into being with the great advance of nationalism in the decade of the Civil War. The Department of Agriculture was established as an independent department in 1862, with a commissioner at its head, and without representation in the cabinet. After making its way against great difficulties for many years, it became a fully organized department of the government in 1889, its head becoming a member of the President's cabinet. The Bureau of Education, on the other hand, first organized as an independent department, without cabinet representation, in the year 1867, was transformed into a bureau of the Department of the Interior in 1869, and that has been its status down to the present time. The movement of congressional appropriations for these two offices is shown side by side, at ten-year intervals, in the following table:

	Department of Agriculture	Bureau of Education (Including after 1880 the Alaska Service)
1870	156,440	5,400
1880	201,000	26,995
1890	1,669,770	104,920
1900	3,726,022	116,270
1910	12,995,274	284,200

Three years later the annual appropriation for the Department of Agriculture had advanced to $22,894,590.

It may not be altogether fanciful to suggest that one reason why Congress is reluctant to enter upon any considerable increase of appropriations for the education office is a fear of the breaking loose of another avalanche of expenditure like that for the agricultural department. However, when one looks upon the great contribution which that department has made to our national prestige and prosperity, it will be seen that this is a consideration which may cut both ways.

For my own part, I have no doubt that when we get any clear vision of the meaning of science and education and the arts in our national life, we shall have liberal appropriations for these objects from the federal government; and that any interpretation of the limitations upon the federal government which would stand in the way of such appropriations, will then be regarded as fanciful and "academic."

No one can foretell how that vision will come to the American people. It is, in fact, slowly dawning at the present time. But its coming must be accelerated, or we shall have long to wait. One thing that may be expected to quicken our national insight in this regard is the growing pressure of international competition, especially in the field of commerce and industry. The opening of the Panama Canal will open the eyes of the American people in unexpected ways. Then, too, the political movement toward democracy and more democracy, as represented by direct primaries and other new forms of governmental apparatus, is making a nation-wide demand for heightened efficiency in our educational systems. Not long ago, this last-mentioned view was presented with great clearness by Senator Burnham, of New Hampshire. There are other tendencies of our time which are carrying us surely in the same direction. Our country simply can not make itself what it would be, both at home and abroad, without more of national emphasis upon the education of the whole people, and upon that advance of science and the arts on which both modern education and modern government depend.

III

In this paper I have drawn freely upon my own recollections, simply as straws in-

dicating the way the wind has blown in recent years at Washington. And I have ventured to forecast a change of weather which must sooner or later affect our national education. Sooner rather than later, I think, but I am not a prophet, to foretell the day and the hour. Now, in the space which I may still use, I should like to offer a few brief suggestions regarding the form which our new national education may be expected to take.

The question is much larger than that as to the future of the Bureau of Education. Its principal elements are those relating to a national university, to federal aid for elementary schools, to the promotion of agricultural and other technical education in secondary and higher institutions; and finally those relating to the Bureau of Education, which must, after all, have an important place of its own in the general scheme. We pass over the military and naval academies, the schools for Indians, and other special educational undertakings in which our government is engaged; and this paper must be limited to the problem, as old as our federal government itself, of a national university. Here we shall try only to get some glimpse of the bare framework of a vast design.

There is one side of our whole national life and national government which is neither economic nor political but scientific, and must be scientifically discerned. The problem of a national university is the problem of the organization of this scientific side. In some few of the states it has been measurably recognized and organized in state universities. In our federal system it has been recognized fragmentarily, and as a result various special commissions and scientific bureaus have come into existence. What is lacking is a unitary organization. And that unitary organization is requisite in order that every piece of scientific work done for the government may have back of it the whole force of established scientific method, standards, and processes, of scientific atmosphere and the ethics of science, which is realized only where many scientific departments work together long and continuously.

A special tariff commission or any other sudden and temporary scientific commission is a makeshift at the best. It will be found at length that what is needed, in place of these, is a continuous and many-sided study of wages, industrial conditions, and cost of production, the world over, carried on under conditions favorable to scientific progress, and in close connection with countless other inquiries with which these are interwoven.

We shall find, indeed, that a scientific branch of government, complete in itself, with its own traditions and its own methods, is as essential to the health of a modern nation as is a judicial branch, complete and sufficient in itself, and with its own juridical forms and procedure. It is necessary that this scientific side of our federal life be made a national entity, and given a fair opportunity of acquiring impressiveness and influence suited to its nature; and that is an opportunity of becoming a really commanding force in our national affairs in proportion to the service it is capable of rendering.

In concrete terms, this would involve a separation of those existing offices of the government which are chiefly investigational in their character from those which are chiefly administrative; the grouping together of those of the former class, under some convenient working system; and the organization of new divisions, somewhat similar in character to the scientific bureaus already in existence, in order to deal with new needs as these shall become apparent and urgent. The process may very likely

be a slow one; but it is a building for the centuries, and the movement toward a comprehensible end is the principal thing at the present time.

Among the offices and institutions to be brought together in this unique university would naturally be the Library of Congress, the permanent organization of the Census Office, the Geological Survey, the Bureau of Standards, the Naval Observatory, and possibly the more strictly scientific offices of the Department of Agriculture. The Bureau of Education should be included, so far as its typical activities are concerned, provision being made elsewhere for the discharge of its administrative functions. It does not appear that the special form of organization of the Smithsonian Institution would prevent it from being made a member of this central group, in which its membership, with that of the National Museum, would be of the utmost importance. If not incorporated in the new organization, it should at least be related to it through some close affiliation.

A very fair beginning might be made with such a group. It should be reasonably clear that a university so constituted at the outset would be different from any that the world has hitherto seen. It would indeed be an institution of national dimensions, as well as of national functions.

It is not to be supposed that the mere putting together on paper of these great government offices would make such a national university as is here proposed. The federal legislation which should bring them into one interlocking group would be but the bare beginning. The adjustment of their mutual relationships, the rounding out of the organization by the addition of needed departments and activities, the settlement of the relations of the university to other branches of the federal government and to educational systems and institutions throughout the country—all of these things will call for imagination and foresight and administrative ability of the highest order. Under the authority and with the support of the Congress of the United States, the offices and governing boards of the new institution will have the responsibility of shaping a real organ of enlightenment, which shall not only be for all of the sciences and for all of the people, but shall be an effective working instrument as a whole and in its several divisions.

The relations of such a national university to other scientific foundations and institutions of learning, at home and abroad, will be of the utmost consequence. So far as American universities are concerned, its relations with them may have something of the "federal" character. It will not supplant them; it will not merely supplement them; to some extent, I think, it will have its existence in them, and they will be participants in its life.

As I conceive it, the national university will be a teaching body as well as an investigating body, but it will not confer any academic degrees. As a teaching body, it will escape the reproach of abstractness and lack of system which lies against some laboratories and bureaus of pure research. Its teaching courses, which must necessarily be of an advanced grade only, may be brought into very fruitful relations with a reorganized office for the federal civil service. On the other hand, to withhold from it the power to confer the traditional degrees, will be to emphasize its unique character, and in the end will add to its strength and influence. Let universities such as we now have, continue to celebrate their commencement occasions and bestow their beribboned diplomas, undisturbed by any federal competition. These things are not unimportant, but the institution that is here proposed will have other and rather

more weighty business. Nevertheless, it is inevitable that if its work be well done it will eventually become the foremost factor in determining the standard and the standing of American scholarship and American degrees before the nations of the world, and consequently before our own people here at home.

The investigation of a network of problems of labor, the costs of production, customs duties, commercial relations, and the regulation of corporations, will be one of the earliest undertakings which a national university may be expected to place upon a scientific basis. Its studies in this field will of necessity extend over decades and even generations. But within a few years there should be assembled and made available for use a greater body of digested information on these subjects than any Congress or administration in this country or any parliament or ministry abroad has ever had, on which to base its industrial legislation.

To amass information, however, is not of itself scientific. What is to be chiefly hoped is that from such researches, in which closely related sciences shall be cultivated together and all upon the largest scale, there shall emerge new and enlightening theories, embodied in new and well-grounded principles of social development.

Finally, if I have spoken thus far of the sciences only, it is not meant to the exclusion of the arts. Quite the contrary. In a more profound sense than is commonly believed, the arts are bound up with the sciences in the making of our civilization. Music, sculpture, and painting are, generally speaking, mere hangers-on in our scheme of higher education to-day. This is one of the defects in our university life which the nineteenth century has handed on to the twentieth. It is one of the defects which a national university should help us to correct. If we are to have anything like national standards in our drama, in our fiction and our verse, in the aggregate architecture of our cities, in the fine arts generally—still more, if we are to make a disciplined sense of beauty sustain, correct, and supplement the scientific trend of our life—our national university must help us in this great work. At best, it is a slow work and a mighty. We shall do well if another century shall find us far advanced upon it.

What has been offered here is only the barest outline of a great hope and dream for our national life. It will seem far removed from those briefly jotted experiences with which this article began. It is a hope and dream which those experiences, however petty by comparison, did not in any measure dampen or abate. Indeed, while I had at Washington a keen sense of the disproportion between the work in which I was engaged and the work of that kind which this country imperatively needs, I went on in that work with a growing conviction that no greater or lesser perfomance of my own or of any other commissioner, no favoring or adverse attitude of successive secretaries, congresses, or presidents, can in the long run prevent this country from erecting its great national institution of education, science, and the arts, at least coordinate with the traditional branches of government, in which all systems and institutions of science, art, and education throughout the land shall be participants, and shall find therein a new realization of their best ideals.

Elmer Ellsworth Brown
New York University

Local Branches of the American Association for the Advancement of Science

At the Atlanta meeting of the American Association for the Advancement of Science the following resolutions were unanimously adopted:

Resolved, That the council of the American Association for the Advancement of Science authorizes the establishment of local branches of the association in places where the members are prepared to conduct branches which will forward the objects of the association.

Resolved, That the standing committee on organization and membership be instructed to promote the establishment of such local branches.

The plan of regional division and local branches has been under consideration for some time. Last year a Pacific Coast division was established and an associate secretary for the south was appointed. At the Atlanta meeting a Brazilian division was authorized. There is every reason to believe that a forward step in the advancement and diffusion of science can be taken by the establishment of local branches, especially in places where there are no chapters of the Society of the Sigma Xi, academies of science, or similar organizations. Even where such agencies already exist, a union of the members of the American Association might cooperate with them for their common interests. A local branch can arrange for lectures, scientific programs, dinners and social meetings, which will bring together those interested in the progress of science, will encourage them in their work and improve the conditions under which it is done, and will increase the interest of the community in science. If a number of local branches are formed in a state or a region it will be possible to arrange for joint meetings or for a lecturer to address meetings in the different places.

The great increase in the number of scientific men, their scattering in this country over a vast area and the differentiation of their work have made it difficult or impossible for them to come together at national meetings and discuss their common objects. The advance and necessary specialization of science tend to divorce it from the interests of the people on whom in a democracy it must depend for recruits and for support. Local societies or clubs, especially in smaller centers where there are not enough scientific men to form groups of specialists and where lectures and scientific programs are not common, can accomplish a great deal to maintain interest in research and to impress its importance on the general public. They will be aided by the prestige of the history and the national scope of the American Association with its eight thousand members and will in turn strengthen the work and influence of the association.

The standing committee of the association on organization and membership, of which Dr. W. H. Welch, of the Johns Hopkins University is chairman, the permanent secretary, Dr. L. O. Howard, is a member, and Professor J. McK. Cattell, Garrison-on-Hudson, N. Y., is secretary, has been authorized to promote the formation of such local branches and the secretary of the committee will be glad to correspond with members of the association who may be interested in the formation of local branches which will promote the objects of the association in their neighborhoods.

SCIENTIFIC NOTES AND NEWS

THE Senate has confirmed the nomination of Col. William C. Gorgas as surgeon-general of the United States Army.

DR. WALTER P. BRADLEY has resigned as professor of chemistry after twenty-five years of service at Wesleyan University to take charge of the investigations of the United States Rubber Company in whose employ he recently spent a year's leave of absence.

DR. EDWIN G. CONKLIN, profesor of biology in Princeton University, has been elected a foreign member of the Royal Bohemian Academy of Sciences.

DR. SAMUEL AMBERG, of The Otho S. A. Sprague Memorial Institute Laboratory, of Chicago, has been elected a corresponding member of the Society of Internal Medicine and Pediatrics in Vienna.

DR. ADOLF FRANK, known for his important contributions to agricultural chemistry, celebrated at Charlottenburg, on January 20, his eightieth birthday.

PROFESSOR W. M. DAVIS, of Harvard University, plans to carry out an exploration of some of the coral islands in the Pacific. He is so arranging his tour as to be able to attend the

meetings of the British Association in Australia.

Professor E. W. Brown, of Yale University, has accepted the invitation of the British Association for the Advancement of Science to attend the Australia meeting in 1914. He expects to be absent from the university until February, 1915.

Dr. J. C. Arthur and Mr. F. D. Fromme, of Purdue University, are making a botanical trip through Texas, New Mexico and Arizona during the month of February. The special object of the trip is to obtain additional information on certain species of Uredinales, whose life histories are incompletely known.

Professor George B. Rigg, of the University of Washington, is absent on leave for the rest of the academic year. He is at the University of Chicago.

Walter Wallace Weir has been placed in charge of cooperative drainage experiments being carried on at Kearney Park, near Fresno, on the 5,400-acre ranch belonging to the University of California. The University and the Office of Experiment Stations of the United States Department of Agriculture are making these investigations in the reclamation of alkali lands by drainage ditches and a pumping system.

We learn from *Nature* that Mr. J. I. Craig has been transferred from the directorship of the meteorological section of the Egyptian Survey Department to the controllership of the Department of Statistics, and has been succeeded at the survey by Mr. H. E. Hurst.

Mr. W. Lawrence Balls, botanist to the Egyptian government, Department of Agriculture, has left the service and is returning to Cambridge to work up the data on cotton which he has collected.

Dr. Emil Abderhalden, professor of physiology at the University of Halle, will lecture at Columbia University next autumn.

Professor Dana Durand, of the University of Minnesota, formerly director of the United States Census, will lecture at Harvard University in April on combinations and trusts.

Professor D. W. Johnson, of Columbia University, recently gave an illustrated lecture before a joint meeting of the American Scenic and Historic Preservation Society and the American Museum of Natural History on the subject "The Scenery of the Atlantic Coast and Its Answer to the Question: Is the Coast Sinking?"

Professor Waldo H. Norris, of Grinnell College, will lecture on zoology at Harvard University this term under the exchange agreement with colleges of the middle west.

Dr. W. P. Mason, professor of chemistry in the Rensselaer Polytechnic Institute, lectured on January 29, before the Franklin Institute of Philadelphia, on advantages and disadvantages of water storage.

Dr. John P. Stewart, professor of experimental pomology of the Pennsylvania State College, during the current fall and winter has lectured before the Maine State Pomological Society, the Massachusetts Fruit Growers' Association and the New Hampshire State Agricultural Convention on "The Results of Seven Years' Experiments with Different Cultural Methods, Covercrops and Fertilization in Apple Orchards."

Dr. W. B. Scott, Blair professor of geology and paleontology at Princeton University, is giving a course of six lectures on the theory of evolution before the Wagner Free Institute of Science, Philadelphia. The lectures which are given on Saturday evenings are on the Richard B. Westbrook Free Lectureship.

Dr. Dayton C. Miller, professor of physics in the Case School of Applied Science, has delivered before the Lowell Institute, Boston, a series of eight lectures, the subjects of which were as follows: January 20, Sound, Sound Waves, Character of Sounds; January 23, Pitch, Loudness, Tone Color, Pure Tones; January 27, Methods of Recording and Photographing Sound; January 30, Effects of Horn and Diaphragm on Sound; February 6, Tone Qualities of Various Musical Instruments, Ideal Tone; February 10, Physical Characteristics of Vowels and Other Sounds of Speech; February 13, Synthetic Reproduction of the

Tones of Instruments, of Vowels and Spoken Words.

AT the College of Medicine of the University of Illinois, Chicago, Drs. Bartlett, Burmeister, Davis, Dreyer, Eycleshymer, Falls, Fantus, Hartung, Miller, Moore and Welker recently organized a medical research club of the University of Illinois. Dr. D. J. Davis was elected president, and Dr. Wm. H. Welker was elected secretary for the balance of the college year. Dr. Eycleshymer presented a paper entitled, "Some Observations on the Decapitated Young *Necturus*."

THE *British Medical Journal* understands that arrangements have nearly been completed for the establishment, as a memorial to Lord Lister in Edinburgh, of a Lister Institute. It is proposed that the institute, which will be devoted mainly to research in bacteriology and pathology, shall work in connection with the university, but that it shall be managed by an independent board consisting of representatives of the Royal Colleges of Physicians and Surgeons, and of the university, and probably of the Carnegie trustees, who have recently become interested in the laboratories of the Royal College of Physicians. It is intended that certain facilities for teaching shall also be provided. It would appear to be the intention that eventually all pathological work, both in research and teaching, in Edinburgh shall be under the general supervision of the professor of pathology, who, in addition to holding that chair and taking an appropriate share in the conduct of the new institute, will act as honorary pathologist to the Royal Infirmary.

DR. WILLIAM KELLY SIMPSON, professor of laryngology at the College of Physicians and Surgeons, Columbia University, died on February 6, aged fifty-eight years.

DR. K. H. F. ROSENBUSCH, formerly head of the geological-mineralogical laboratory at Heidelberg, distinguished for his contributions to mineralogy, has died at the age of seventy-eight years.

DR. FELIX HAHNSCHAFFE, professor of geology in the Berlin Mining Academy, has died at the age of fifty-three years.

THE U. S. Civil Service Commission announces an open competitive examination for assistant chief, Bureau of Chemistry, to fill a vacancy in this position in the bureau of chemistry, Department of Agriculture, at $4,000 a year. It is desired to secure the services of a man of broad training and extensive practical experience in physiological chemistry and medicine as well as experience as an administrative officer to assist in the research and supervisory work of the bureau of chemistry, and the enforcement of the food and drugs act. Applicants will not be assembled for examination, but their relative qualifications will be rated upon the evidence adduced as to their education and training, practical experience and fitness, and their publications. Applicants must give in their applications a complete statement of their educational training, a complete statement of their practical experience, and a list of their publications. Copies of such publications should be filed with the application. An educational training including an M.D. degree from a medical school of recognized standing and special training in analytical and physiological chemistry other than that included in the medical course; and not less than three years' experience as a medico-legal expert, and some experience as an administrative officer, are prerequisites for consideration for this position. Applicants must have reached their thirtieth but not their forty-fifth birthday on the date of the examination.

UNIVERSITY AND EDUCATIONAL NEWS

BOWDOIN COLLEGE has received a bequest of $500,000 for the general fund of the college from the estate of Edwin B. Smith, former assistant attorney general of the United States, who died in New York on January 5.

YALE UNIVERSITY receives $500,000 under the will of Lord Strathcona and Mount Royal, who died on January 21. The Royal Victoria College at Montreal, a girls' school, is given $1,000,000. Lord Strathcona leaves to St. John's College, Cambridge, $50,000; to the University of Aberdeen, for the creation of a chair of agriculture, $25,000; to the Presby-

terian College at Montreal, $60,000, and to Queen's University, Kingston, Canada, $100,000. In addition to this sum he bequeathed to the Royal Victoria Hospital at Montreal $500,000, and to hospitals in the British Isles, $90,000. The bequest to Yale University is

> for the promotion of the modern sciences, and for instruction in the practical questions arising from the application of scientific knowledge to the industrial, social and economical problems of the times, it being my special desire to have the said sum expended so far as in the opinion of my trustees may be deemed advisable for instruction in civil and mechanical engineering, with special reference to the construction, equipment and operation of transportation of passengers and freight, whether by land or water, and the financial and legislative questions involved.

Through the will of the late Mrs. Elizabeth Mattox, of Terre Haute, the sum of $45,000 will be added to the general endowment of De Pauw University.

Mrs. William Porter Herrick, widow of the late William Porter Herrick, has given to the University of Colorado, $5,000, to be used as an aid fund for worthy students.

Sir Hildred Carlile, M. P., has given $500,000 to Bedford College, London, as a memorial to his mother, Mrs. Edward Carlile.

Dr. Hugo Frommsdorff, on the occasion of the fiftieth anniversary of his doctorate, has given $5,000 to the University of Heidelberg for a foundation for the advancement of chemistry.

According to the daily press President Edmund J. James, of the University of Illinois, called, on February 3, a meeting of the faculty and announced that he had received reports that he did not possess the confidence and support of the faculty without which he did not wish to retain the presidency. The faculty in secret ballot by a vote of 188 to 4 declared confidence in President James.

It is announced that Dr. Frank J. Goodnow, Eaton professor of administrative law and municipal science at Columbia University, at present constitutional adviser of the Chinese Republic in Peking, has been offered the presidency of the Johns Hopkins University.

Dr. M. A. Brannon, professor of biology in the University of North Dakota and dean of the college of liberal arts, has been elected president of the University of Idaho.

DISCUSSION AND CORRESPONDENCE

LABELLING MICROSCOPIC SLIDES

Within the last year or so Science has published four short articles on labelling slides.[1] From this it would seem to be a subject of some interest. I have therefore ventured to add a method which I have been using with entire satisfaction for some time past.

The objections to scratching slides or other glassware with a diamond or carborundum is that the label can not be removed, if for any reason this is necessary. Another objection that is equally serious is the difficulty of making clear and legible labels where several words must be written. These reasons led me to abandon this method long ago.

Marking with wax pencils is of doubtful value owing to the extreme care necessary to avoid removing the label through contact with xylol or by mere rubbing. My own experience with waterproof ink has been that it is also too easily rubbed off or washed off while passing slides through water or aqueous stains.

Etching or grinding the surface of the slide is satisfactory where the surface thus prepared is to be used frequently but is entirely too troublesome for ordinary slides. Moreover, the pencil label is not always easily legible.

I now use an ordinary india ink (l'encre de chine) to which I have added a little ordinary water glass (sodium silicate solution) such as is sold at the corner drug store for preserving eggs. It is usually better to thin, after adding the water glass, with enough water to make the ink flow freely. With this ink one can write with a fine pointed pen any label that he

[1] A. F. Blakeslee, "A Labelling Surface for Glassware," Science, 37: 561, 1913; Zae Northrup, "A New Method for Labelling Microscopic Slides," Science, 38: 126, 1913; Ernest Shaw Reynolds, "Labelling Microscopic Slides," Science, 38: 363, 1913; Frank E. Blaisdell, "Labelling Microscopic Slides," Science, 38: 665, 1913.

would have been able to write on paper. It can be put on the slide as soon as the paraffin ribbon has been mounted. If the slide was clean when the label was written, water, alcohol and xylol may be applied to it freely without any danger of injury. Ordinary abrasion such as the slide frequently encounters in use will not in any wise affect the permanency of these labels. They can, however, be scratched off easily with a dull knife (or scrubbed off with scouring soap). A white paper label pasted on the *back* of the slide will make it even more conspicuous.

LANCE BURLINGAME
STANFORD UNIVERSITY, CALIFORNIA,
January 14, 1914

A NEW NAME FOR THE MARMOT OF THE CANADIAN ROCKIES

MR. ARTHUR H. HOWELL has called my attention to the fact that the name applied by me to the large marmot from the Moose Pass branch of the Smoky River, Alberta, *Marmota sibila*,[1] is preoccupied by *Arctomys sibila* Wolf.[2] The marmot of the Moose Pass region may be called *Marmota oxytona*.

N. HOLLISTER
U. S. NATIONAL MUSEUM,
November 5, 1913

SCIENTIFIC BOOKS

Mathematical Monographs. Edited by MANSFIELD MERRIMAN and ROBERT S. WOODWARD. No. 12. *The Theory of Relativity.* By ROBERT D. CARMICHAEL. New York, John Wiley & Sons. 1913. Pp. 74.

Unlike most presentations of the theory of relativity, which contain a considerable amount of technical mathematical physics, Carmichael's is non-technical and logical in the same way that the discussion of the foundation principles of geometry or mechanics or chemistry might be made non-technical and logical. The book may, therefore, be read with ease by the mathematician who has little or no knowledge of modern physics or by the physicist who is unacquainted with mathematical analysis; it might be read by the engineer or, for the most part, by the philosopher. The work is in no sense a mere compilation from the investigations of previous authors, but represents a considerable amount of independent investigation of which the major part has appeared in contributions to the *Physical Review*.

The strongest and most satisfactory part of the book is that dealing with the statement of the postulates upon which the theory is built and with the direct consequences of the postulates. Less final and satisfactory are those parts where the physical theories (as distinguished from the results of physical experiments) which might conceivably underlie the theory are mentioned. This lack of finality and satisfaction is, however, quite unavoidable in these latter days when so many phenomena apparently subversive of long-accepted notions are constantly being unveiled. One has only to read the report on "La Théorie du Rayonnement et les Quanta,"[1] of the colloquium held at Brussels in 1911 to see in what a state of partial bewilderment and contradiction are the leading physicists of our time. The riot of new hypothesis and theory in the last volume (No. 26) of the *Philosophical Magazine* is a similar indication.

The author abstains from electromagnetic theory and confines his attention to the relation of the theory of relativity to the concepts of length and time, of mass and energy; he has, however, to mention that fundamental unit of electricity, the electron. He does well to emphasize the independence of the theory of any hypothesis as to the existence or non-existence of the ether, even though he subsequently finds it useful to make use of the ether in discussing the physical nature of mass. He could profitably have gone a little more into detail with regard to the relation between the ether and relativity.

Once we admit the existence of a stagnant ether, we have at hand at least a logical fixed system of reference; we may logically speak of

[1] Smithsonian Miscellaneous Collections, Vol. 56, No. 35, p. 1, February 7, 1912.

[2] Linne's "Natursystem," Vol. 2, p. 481, 1808.

[1] Langevin and Broglie, Gauthier-Villars, 1912.

absolute motion, even though we may be unable experimentally to determine the absolute motion; the change of mass and of length which arise in moving systems are then but the natural consequences of the redistribution of the lines of force issuing from the moving charges; our concept of time and distance is no longer in need of modification; we have essentially the original Lorentz point of view. The theory of relativity then is merely a collection of results interpreted on moving axes (with local time) and abstracted from the underlying ether; the fundamental postulate *M* of the theory, that we can not detect absolute motion, is a natural consequence of the fact that the transformations between different sets of moving axes (and times) form a group. For instance, if two particles move in different directions through the ether each is actually shortened in the direction of motion, but observers attached to the particles can observe no shortening because everything in the system is similarly shortened. And moreover, since the transformations above mentioned form a group, each observer, abstracting from any conception of the ether and experimentally unaware of any shortening in his system, concludes that the system of the other observer is shortened in the direction of their relative motion and by the amount appropriate thereto.

On the other hand, if we take the point of view that what we can not directly observe does not exist, if we take the theory of relativity as itself fundamental and banish the ether, then we have no such physical or conceptual basis upon which to explain the shortening, the alterations in mass, or the changes in time, and we are forced to change our concepts of mass, length and time; we are forced to all those new ideas which the theory of relativity brings in and which seem incongruous or bizarre to many persons, and these ideas assume a semblance of naturalness only when our universe is interpreted as four-dimensional with space and time unified and inherently interrelated, in the manner adopted by Minkowski or Wilson and Lewis or McLaren. Which of the two points of view we adopt depends largely upon our turn of mind. There are philosophers who feel that we are entirely free to construct for ourselves any image of the physical universe which seems most natural and easy; they will probably hold to the ether as long as possible. There are others who feel that we should not intrude into the image any ideas which represent things not immediately subject to experiment; they will declare for the principle of relativity as fundamental and not as derived, just as Walther Ritz declared against electric and magnetic field-intensities *E* and *H*.

The author knows all this and covers most of it in different parts of his work, but seems nowhere to collect it. The brief discussion of the mass of light is too indefinite to convey any useful impression to me. The attempt at the end of the work to outline a further experiment bearing on the theory is laudable in itself and shows that the author has thought deeply into his subject from other sides than the logical.

Edwin Bidwell Wilson
Massachusetts Institute of Technology

Osmotic Pressure. By Alexander Findlay. Longmans, Green and Co., New York. Cloth, 8vo. Pp. 84. Price $1.00.

This book by Dr. Findlay is one of the series of monographs on inorganic and physical chemistry of which he is the editor. The purpose of these monographs is "to place before advanced students of chemistry, accounts of certain sections of inorganic and physical chemistry fuller and more extended in scope than can be obtained in ordinary text-books." The present monograph deals with semi-permeable membranes and osmotic pressure, 6 pages; van't Hoff's theory of dilute solutions, 4 pages; direct determination of osmotic pressure of concentrated solutions, 12 pages; discussion of the recent determinations of osmotic pressure and of the van't Hoff theory, 4 pages; the general theory of ideal solutions, 10 pages; discussion of the osmotic pressure of aqueous solutions of cane sugar in the light of the theory of ideal solutions, 13 pages; indirect determinations of the osmotic pressure, 15 pages; views regarding the cause of osmosis

and the action of the semi-permeable membrane, 12 pages. Three pages are devoted to references. Two figures appear in the text. The treatment does not claim to be exhaustive "so far as concerns work important in its time but now only of historical interest," the aim being to give special attention to recent investigations.

The amount of space devoted to thermodynamical considerations and the so-called theory of "ideal" solutions, together with the mode of treatment and what one reads between the lines, clearly shows the author's leanings. It is, however, quite safe to say that those who have actually spent their time in the laboratory at practical work with innumerable solutions and diverse osmotic membranes, entertain very little hope of a better understanding of solutions and osmosis from thermodynamical computations and mathematical equations of what are termed "ideal solutions." One might indeed about as well talk of an ideal chemical compound, an ideal plant, or an ideal animal, as of an ideal solution.

The monograph will doubtless prove useful to students of the subject of osmosis, especially because of the references to the recent literature, even though these be incomplete. It moreover also contains a good, clear exposition of the existing physical theories of osmosis and solutions. But in a publication of this kind, which is especially intended for students, one has a right to expect something that will inspire and spur the student on to further experimental inquiry in the subject. In this respect, however, the monograph is sadly lacking, and how can it be otherwise, for to those that seek to solve the problem by thermodynamics and theories of "ideal solutions" new experiments along specific lines naturally do not suggest themselves, for they are really not required for the purpose of the explanation. A theory of "ideal solutions" suggests chiefly how known facts can be harmonized with it and how the "troublesome exceptions" may be accounted for; it does not suggest how new fields may be opened up. To those that thus vainly hope to solve the practical problems of solutions and osmosis particularly as they relate to organic beings, one may well quote the immortal words of Goethe, "Grau teurer Freund ist alle Theorie und grün des Lebens goldener Baum."

LOUIS KAHLENBERG

THE BOTANICAL SOCIETY OF AMERICA

THE eighth annual meeting of the Botanical Society of America was held in the State Capitol Building, at Atlanta, Georgia, December 30, 1913, to January 1, 1914, about ninety members being present. The following officers were elected:

President—A. S. Hitchcock, U. S. Department of Agriculture.

Vice-president—B. M. Duggar, Missouri Botanical Garden.

Councilor—D. G. Fairchild, U. S. Department of Agriculture.

One hundred and thirty new members were elected to the society.

The report from the committee on the new journal was adopted. This provides for a cooperative arrangement with the Brooklyn Botanic Garden which will make possible the immediate publication of the journal and the first number of the *American Journal of Botany* will appear during January. All members of the society become contributing subscribers to the *Journal*, the price being fixed at $3.00 annually to members and $4.00 to non-members. Attention is called to the fact that candidates for membership (meaning those whose applications were received too late for action or those who may apply for membership during the year) may, upon approval of the council, receive the journal at the same rate as members.

The address of retiring President L. R. Jones on "Problems and Progress in Plant Pathology," together with the symposium on "Temperature Effects," participated in by Dr. Frederick Barry, Dr. B. M. Duggar, Dr. D. T. MacDougal and Dr. Forrest Shreve, will probably be published in the new journal of the society.

The dinner for all botanists was held New Year's night, the topic for discussion being the new journal.

Following are abstracts of the papers presented at the general sessions and at the newly organized physiological section:

The Seasonal Life History of Some Red Algæ: I. F. LEWIS.

Experiments were performed at Woods Hole dur-

ing 1911, 1912 and 1913 on the following species: *Griffithsia Bornetiana, Dasya elegans* and *Polysiphonia violacea.* Tetraspores and carpospores were planted on oyster shells, which were then fastened to piles and left during the winter. The annual life cycle of the species studied runs as follows:

In June young plants become visible. These produce, for the most part, tetraspores, though an occasional sexual plant may be found. The tetraspores are released in July and germinate immediately to form the second crop, which consists of sexual individuals. These often occur on other algæ and *Zostera,* whereas the first crop of tetrasporic individuals is confined to stones, piles and other objects of a more or less permanent nature. The sexual crop releases its carpospores in August or early September. It is the small sporelings from these spores which winter over. The individuals which have attained any considerable size all die at the approach of cold weather. The tiny holdfasts of the very young sporelings may be seen during the winter and spring. From them arise the tetrasporic plants of the first summer generation.

The alternation of generations in these species is thus connected with their seasonal occurrence. The sexual generation is characteristic of late summer, while the tetrasporic plants survive the winter and predominate in early summer.

There is no sharp line between the first and second crops, as a small percentage of both occur out of season. This is particularly true of the tetrasporic individuals, which under favorable conditions may survive throughout the summer and continue to produce spores up to September. A few of these belated tetraspores form holdfasts which winter over and produce the scarce sexual plants of the early summer following. In general, however, the two crops are well marked.

The Marine Algæ of Peru: Marshall A. Howe.

The specimens on which, chiefly, the paper was based were secured by Dr. Robert E. Coker, now of the U. S. Bureau of Fisheries, while acting as fishery expert for the government of Peru during the years 1907 and 1908. They are referable to about 100 species and they constitute one of the largest collections of algæ thus far made in South America and by far the best ever brought from Peru. For the satisfactory determination of the specimens it has been necessary to examine the original materials of a considerable number of little-known and briefly described South American species. The algæ of Peru has been sparingly collected, especially during a period of seventy-five years preceding Dr. Coker's visit, and about one third of the species found by Dr. Coker appear to be undescribed. Although Peru lies wholly within the tropics, its marine flora, with the exception of a strip of coast about twenty miles long at the extreme north, is of a temperate rather than a tropical character. This is apparently due to the influence of the Humboldt or Peruvian Current, which brings northward the cold waters of the South Temperate and Antarctic regions. The mean summer temperature of the ocean at Callao, latitude 12° South, is said to correspond to that of New York, latitude 41° N., and of Monterey, California, latitude 36° N. Accordingly, one finds the typically tropical genera of green and red algæ poorly or not at all represented on the coast of Peru. Instead, the larger brown algæ, species of *Macrocystis, Lessonia* and *Eisenia,* are the dominating elements in the marine flora.

Lantern photographs were exhibited, showing some of the more characteristic species of the region. Among these were several illustrating the hapteres and the disposition of the sporangia in various forms of *Macrocystis.*

The Trend and Influence of Certain Phases of Taxonomy: Aven Nelson.

Taxonomy has its place. It trains the perceptive faculties, teaches orderliness, develops judgment and strengthens reason. There is a saving grace in botany not found in most of the other sciences and this is exercised through taxonomy more fully than through all the other divisions of botany combined.

Systematic botany furnishes to the average layman a more continuous incentive for pleasurable and inspiring contact with the world about him than any other subject that lays claim to a place in a cultural course. It may be the primitive phase, but most great botanists at least began at this point, thus illustrating in their development the recapitulation theory.

Systematists were never so numerous nor more active than at present. All activity is not necessarily progress. Motion up and down may be spectacular and nothing more.

There is but one reason for the existence of the professional systematist; viz., to make it easier for others to know plants. If we fail in this one thing we fail in all. Judging by the indifference of the multitude to our work; by the hopelessness of the amateur who tries to acquaint himself with

the plants he meets; by the none-too-well concealed cynicism of our colleagues in other lines, we are failing in this. Our work has been analytic, not constructive. We have dismembered organisms and held up to view their component parts. We have been looking for differences, and with such amazing success that the fundamental resemblances have, for the most part, escaped our notice.

Morphology, physiology, ecology and economic botany in its scores of applications have all gone forward by leaps and bounds, but in spite of, not by the aid of, taxonomy. Not all taxonomic work has been useless or erroneous. Keenness of observation and great powers of discrimination are not lacking. It is not so much that what has been should not have been done, but rather that more should have been done to relate recent work to that which has gone before. Synthesis should have followed so closely upon the analysis of the elements of our flora that duplications would promptly have been discovered and the relation of each element to the other detected and stated.

We are on the eve of a new era of reconstruction. Already the pendulum is swinging back toward greater conservatism. The dismemberment of genera and the multiplication of species proceed more cautiously. This grows out of the revitalized aim, "make it easier for others to know plants."

Studies of Teratological Phenomena in Their Relation to Evolution and the Problems of Heredity: I. *A Study of Certain Floral Abnormalities in Nicotiana and Its Bearing on Theories of Dominance:* ORLAND E. WHITE.

Nicotiana plants showing petalody were selfed and progeny grown from them. In one race the abnormal character was extremely variable, some plants showing a large expression, other plants showing it only to a slight degree. This race varied in many other characters, proving the mother plant to have been very heterozygous. In another race, the abnormality was reproduced in all the progeny to the same degree as in the mother plant. With the exception of pollen color, no variation in other characters occurred in this race, indicating that it was largely homozygous in its hereditary constitution.

Pistillody originated as a discontinuous variation and was inherited in the same manner, crosses with the normal in one case giving in F_2 a progeny closely approximating a simple 3:1 ratio. In two hybrid F_1 families, it was completely recessive, while in what appears to be another hybrid F_1 family, it is wholly dominant. The first two families differ from the last family in a large number of characters, as the ancestry of the latter involves another species.

The catacorolla race of *Nicotiana* originated through a discontinuous variation. When crossed with normal races, the F_1 progeny were either intermediate in character or absolutely normal, though the individual F_1 progeny from each cross showed no variation among themselves. Great variation existed between the different pollen parents of many of these F_1 individuals.

As a whole, the data secured from hybridizing races of normal plants with those possessing the three abnormalities discussed above support the view that dominance and recessiveness are not in any way attributes of the factor or "character" in itself, but are the result of the factor expression plus the modifying influence of the environment, whether genotypical (all the other genetic factors of the organism not primarily concerned in the transmission of a particular character) or external (soil, climate, etc.). The variability of the catacorolla expression in the 119 F_1 plants of (—4—1*A* × 119 normals) is striking supporting evidence that this conception of dominance is the most tenable of those recently advanced by genetics.

Observations on the Behavior of Some Species on the Edges of their Ranges: ROBERT F. GRIGGS.

In the Sugar Grove region of central Ohio about 125 species, 13 per cent. of the native flora, reach their territorial limits. These plants are of diverse geographical affinity stretching away in every direction. More than half are abundant in many stations; only $\frac{1}{10}$ are rare; 21 are outliers far from their next station; 27 range continuously up to their limits; 77 reproduce well; only 18 reproduce poorly. The success of the seedlings in meeting plant competition is apparently more important than success of the reproductive apparatus. The theory that plants are confined to their optimum habitats at their termini does not accord with observation. On the contrary, some plants occupy the most unfavorable habitats, being forced by competition to grow where they can find room. The causes of the termination of these ranges is not evident. Climatic adaptability is evidently the limiting factor restricting the spread of species, but there does not appear to be such a climatic adjustment in the present instance, for most of these termini appear not to be stable, but are either advancing or retreating. There are tension zones between the different spe-

cies similar to the tension zones between ecological associations. By observation of these geographical tension zones it is possible to detect the trend of geographical movements. The indications at Sugar Grove are that Boreal types are giving way to others from the west and south. (To be published in the *Bulletin of the Torrey Botanical Club*, January, 1914.)

Variations in Iowa Oaks: B. Shimek.

Iowa occupies a peculiarly favorable position for the study of variations in oaks. Here northern, southern and eastern forms meet, and many of them appear in groves bordering the prairies.

Perhaps because of this, great variation is exhibited by many plants, those of the oaks being among the most striking and interesting.

The paper deals especially with variations in leaves and acorns, though other characters receive attention. Seventeen species and varieties are reported from the state, but chief emphasis is placed on variations in *Quercus macrocarpa*, *Q. alba*, the *Q. acuminata* group, *Q. rubra* and the *Q. coccinea* and *Q. velutina* group. The difficulty in determining species is considered and the value of specific characters is discussed, and special attention is given to the discussion of such disputed species as *Quercus coccinea*, *Q. ellipsoidalis*, *Q. boreale*, *Q. velutina*, *Q. texana* and *Q. Schneckii*.

The distribution of some of the species is discussed, and the record of the range of distribution of several species is corrected.

Segregation of Characters in First Generation Hybrids from Stable Species of Œnothera: Geo. F. Atkinson.

The parents are stable wild species of Œnothera (*Œ. nutans* Atkinson & Bartlett, and *Œ. pycnocarpa* Atkinson & Bartlett),[1] found growing in the vicinity of Ithaca, N. Y. They have been cultivated through two generations. They differ in 25 to 30 clearly observable characters (a close analysis will reveal more) distributed in rosettes, stems, stem leaves, bracts, flowers, habit and propagation. Reciprocal crosses give rise to hybrids which show segregation of characters in the first generation. A number of the characters are contrast characters and behave as unit characters in segregation into twin and tripled first-generation hybrids.

Isomorphism in Capsella Hybrids: Henri Hus.

In an earlier paper, presented at the Cleveland meeting, the presence of a gene *N*, to which the narrow character of the earlier leaves is due, was demonstrated for *Capsella Bursa pastoris Setchelli*. This form was shown also to contain Shull's gene *B*, responsible for the deeply incised primary lobes, as well as for the presence of secondary lobes. At the time it was thought that in the F_1 generation of a plant of the partial zygotic constitution *BbNn*, the combination *BN* was not formed (gametic repulsion). Experiments carried on during 1913 have demonstrated that this combination does exist and also that, whenever a plant is homozygotic for *N*, the identical external appearance obtains, independent of whether the remainder of the ascertained zygotic constitution is *BB*, *Bb* or *bb*. Such combinations always yield the form *arachnoidea*.

On Physiological Isolation in Types of the Genus Xanthium: Charles A. Shull.

Remarkable variations in the burs of what has been considered *Xanthium canadense* Mill. have been noticed in Kentucky, in Kansas and elsewhere during the last several years. Three distinct types were selected in the fall of 1912 from the local flora where all were growing together on the same soil under identical conditions, for breeding experiments. These types have bred true to the parental generation, notwithstanding their close proximity in the field and their unguarded pollination. Differences were noticed in the burs, seeds, leaves, pigmentation, etc., and in the length of time required for the development of the reproductive organs. Because they bloom at different ages the types tend to remain distinct, although there is evidence that occasional hybrids may occur under natural conditions. The genus needs revision based upon experimental investigation.

On an Abnormality in the Flower of the Bellwort (Oakesia sessilifolia) which Prevents Seed Formation: A. F. Blakeslee and A. F. Schulze.

The abnormality consists in transformation of stigmas into anthers containing pollen grains which in sugar solutions germinate, as well as pollen from the normal stamens of the flower. Such abnormal flowers do not set seed.

Variability in a Vegetatively Pure Line of a Hermaphroditic Mucor: A. F. Blakeslee.

Separation cultures from a single spore sowing of the mucor tested gave a small percentage of colonies sharply different from the stock form. The variations consisted in absence and increase or decrease of zygospore production, peculiarities in color, density and rapidity of mycelial growth, differences in height of mycelial filaments, the almost exclusive production of yeast-like cells in

[1] See *Rhodora*, 15: 83–85, 1913.

place of a filamentous mycelium, the production of a filamentous mycelial growth devoid of sporangia, and a partial change at least toward the dioecious condition. Some of these variants are surely temporary conditions for they tend eventually to revert to the normal type. Others may be more permanent but have not been sufficiently investigated. All, however, tend partially at least to reproduce the new characters and some have for several sporangial generations kept their peculiarities in gross cultures during the few months it has been possible to propagate them. Many of them would undoubtedly be described as distinct species by specialists in the group.

The Development of Amanitopsis vaginata and Lepiota clypeolaria: GEO. F. ATKINSON.

Amanitopsis vaginata.—The primordium of the pileus arises in the middle of the upper part of the young carpophore as a dome-shaped area. This soon differentiates into an upper portion, the pileus primordium; and a lower one, the hymenophore primordium. By surface and marginal growth (the latter being epinastic) through the enveloping fundamental tissue, the pileus is formed. By downward and obliquely inward growth of the hymenophore through the fundamental tissue toward the stem fundament the primordial tissue of the lamellæ is formed. This gradually becomes differentiated into the primordia of the lamellæ, the trama of the gills being continuous with the trama of the pileus and the surface of the stem. There is no internal annular gill cavity as in *Agaricus, Lepiota,* etc. The fundamental tissue enveloping the primordia of pileus, hymenophore and stem is the "universal veil," or in fact gives rise to it at a quite late period in the organization of the pileus when an outer zone of the developing pileus changes into a gelatinous cleavage layer.

Lepiota clypeolaria.—Before any evidence of internal differentiation of the primordia of the pileus, hymenophore and stem, the young carpophore presents an outer duplex zone, the "universal veil" of Fries. The inner portion of this zone consists of a thin layer of subpseudoparenchymatous cells, the outer portion of long radially extending threads. After the origin of the stem and pileus fundaments, this "universal veil" is for some time separated from the pileus and stem by a zone of loose fundamental tissue. In the further differentiation of the pileus the surface threads grow through this intermediate zone of fundamental tissue and tie into the inner zone of the "universal veil" so that the latter becomes "concrete with the surface of the pileus," no cleavage layer being formed.

A Preliminary Note on Spore-formation in Cyathus: GUY BISBY.

Practically no work has been done in recent years on this genus, making an examination of some interest. The nuclear divisions in the basidium is followed in *Cyathus vernicosus* by a nuclear division in the spore, making this species binucleated, whereas in *Cyathus stercoreus* the spores remain uninucleated. This cytological feature should be of advantage as a systematic criterion. Hyphæ growing from germinated spores have been observed, in forming anastomoses, to be met by a short protuberance from the hyphæ approached, apparently responding to some sort of attraction.

Variation in the Sporangia and Spores in the Saprolegniaceæ and its Bearing on their Classification: W. C. COKER.

Original observations on such variations are reported and the literature examined. It is concluded that while there is great variation in size, arrangement and behavior of both spores and sporangia, these (with possibly a single exception) are not of a character to confuse our present conception of genera in this family.

A Peculiar Water Mold: W. C. COKER.

A new species is reported from Chapel Hill, N. C., that exhibits in a confusing way certain of the reproductive peculiarities of *Achlya* and *Saprolegnia.* The spores on emerging swim away in part while others remain attached to the sporangium tip.

Occurrence and Periodicity of Water Molds at Chapel Hill, N. C.: W. C. COKER.

The results of about 450 collections are given, showing the relative abundance of the species found and their periodicity in so far as it exists. About 20 species are discussed.

Foliage Resistance of Different Varieties of Potatoes to Phytophthora infestans: I. E. MELHUS.

A study has been made of the varietal resistance of potatoes to *Phytophthora infestans* by artificially infecting the foliage. Varieties reputed to be either resistant or susceptible were grown in the greenhouse and subjected to favorable conditions for *Phytophthora* infection. The conidia of the fungus were germinated in water at optimum temperature conditions (about 13° C.). The resulting zoospore suspension was sprayed in the lower surface of the leaves of the healthy,

vigorous plants from 6 to 12 inches tall. Plants thus treated were held in a moist atmosphere at 20° to 25° C. over night and removed the following morning.

It is believed that by this method it is possible to learn the relative resistance of any variety without growing it under field conditions.

Plus and Minus Strains in the Genus Glomerella: C. W. Edgerton.

Cultures of *Glomerella* from different hosts have been obtained which show the presence of two different strains, these being provisionally called plus and minus strains. The plus strain produces normal perithecia in clumps or masses. The minus strain produces perithecia, usually immature, scattered profusely over the surface of the culture medium. When these two strains are placed in the same plate and allowed to grow together, a dense black ridge of normal perithecia develops on the boundary line. The two strains of one of these fungi have been carried for over three years and are still producing perithecia abundantly. That there is a fertilization between the two strains has been proven by isolating single asci from the boundary line between the two strains and allowing them to grow into colonies. These colonies usually produce both strains.

The Homology Between Spore-forms in the Ascomycetes: C. R. Orton.

It has been pointed out in the rusts that there is a very striking morphological similarity between certain heteræcious species. This morphological likeness may be termed homology. It is pointed out in this paper that a similar homology exists between the conidial and ascigerous stages of certain Ascomycetes with respect to morphology of their spores. Examples are cited and discussed which show the likeness as well as the apparent exceptions. It is hoped that this fact may be of value to the mycologist and plant pathologist as a guide to life-history studies.

A Contribution to the Life History and Physiology of Cylindrosporium on Stone Fruits: B. B. Higgins.

A careful study of the life history of this parasite has brought to light a very interesting polymorphism. Four spore forms were found to be genetically connected in the life cycle as follows: Typical *Cylindrosporium conidia,* produced on delicate stromata in spring and summer; microconidia, produced on the same stromata in late fall; ascospores, produced in apothecia in the dead leaves during the following spring; and apothecial conidia, produced later in the same apothecia following the discharge of the ascospores. All of these except the microconidia are capable of producing infection on the host plants.

A study of the morphological and biological characters of the organism from eight species of *Prunus* showed that the forms under consideration fall naturally into three species, one on each of three more or less distinct divisions of the host genus.

North American Species of Peridermium on Pine: J. C. Arthur and F. D. Kern.

The authors published a paper covering this ground in 1896, since which time much information has been added to previous knowledge, which the authors now propose to summarize. Some of the former names have been reduced to synonymy, chiefly as the result of culture work, and two new species are established, one from California and one from Guatemala. Some three or four species have been introduced from Europe, and are yet local. Doubtless the greatest economic interest centers about the caulicolous forms, native and foreign, and these have been discussed with considerable fulness.

Transpiration of Silphium laciniatum L.: L. A. Giddings.

The experiments discussed in the present paper were carried on with *Silphium laciniatum* L. This plant was selected for experimental purposes because of the fact that it is a xerophyte growing in very dry exposed prairie regions and because, being taller than most of our native prairie plants, it offers opportunities for the study of normal transpiration in relation to evaporation at different altitudes above the surface of the soil.

The paper includes a discussion of the experiments carried on in the laboratory and in the field. A part of the experiments were carried on in the plant physiology laboratory of the State University of Iowa. The field experiments were carried on at the Macbride Lakeside Laboratory on West Lake Okoboji during the summer of 1912. Material for the study of the structure of the leaf was collected at the same time that the field experiments were being performed.

In the laboratory special attention was given to the effect of increased wind velocity on the rate of transpiration. Evaporation experiments were run with the transpiration experiments for comparison. In the field experiments attention was also given to the effect of wind velocity on

the rate of transpiration, but in these experiments relative humidity was also carefully studied and a comparison between the time of day when the lowest relative humidity occurred and the time of day when evaporation and transpiration were greatest. The rate of transpiration of leaves taken at different heights was studied, together with evaporation at the same heights.

The laboratory experiments showed that the rate of transpiration increased with wind velocity up to a certain limit, after which it did not increase in proportion to the increase in wind velocity. As a rule, in the field experiments transpiration was greatest before evaporation had reached a maximum.

The Effect of Certain Surface Films and Powders on the Rate of Transpiration: B. M. DUGGAR and J. S. COOLEY.

It is commonly observed that leaves of plants sprayed repeatedly with Bordeaux mixture may remain green and healthy, towards the close of the season, several weeks after unsprayed leaves free from fungous diseases have ripened. The experimental work reported up to this time has afforded no data indicating differences of sufficient magnitude between the activities and unsprayed leaves to account for the extended vegetative period. The experiments here reported were made for considerable periods of time with standardized castor bean leaves in potometers and with large numbers of potted tomato plants. Bordeaux mixture, aluminium mixture, lime, and certain other film-forming liquid and powders were employed. In every case the rate of transpiration was higher in the Bordeaux sprayed plants than in the controls, or as compared with the standard. The important differences make it necessary to give weight to increased transpiration in any explanation offered.

The Relation Between the Transpiration Stream and the Absorption of Salts: HEINRICH HASSELBRING.

During the winter of 1908–1909 experiments were conducted at Santiago de las Vegas, Cuba, in order to determine the comparative transpiration of tobacco plants under cheese-cloth shade and in the open ground. For this purpose plants were grown in galvanized iron tanks which were set into outer encasing tanks permanently sunk in the ground. Six tanks were placed among the plants of a field of tobacco grown under cheese-cloth, and six were set in an adjoining tobacco field not shaded. The quantity of water transpired by the plants in the tanks was determined by daily weighings, the quantity transpired being replaced each day. At maturity the leaves, stems and roots of each plant were harvested separately, dried and ground. The ash was determined in water-free samples of the ground material. From the data the total ash of the plants was calculated.

The plants grown in the open absorbed about 28 per cent. more water than those grown under shade. The plants which absorbed and transpired the greater quantity of water contained both the smaller percentage and the smaller absolute quantity of ash.

It appears, therefore, that the absorption of salts by roots is independent of the absorption of water, and that the transpiration stream does not exert an accelerating effect on the entrance of salts.

Relation of Transpiration of White Pine Seedlings to Evaporation from Atmometers: G. P. BURNS.

An attempt was made to express the data recorded by meteorological instruments in terms of plant physiology and thus give them a botanical significance. The experiments were conducted in the state forest nursery under different degrees of "shade."

A comparison of the water loss from white and black atmometers with that from white pine seedlings under three conditions of shade used gave the following coefficient of transpiration:

Half shade	.0088 for black atmometer.
	.0087 for white atmometer.
No shade	.062 for black atmometer.
	.084 for white atmometer.
Full shade	.036 for black atmometer.
	.044 for white atmometer.

By use of these coefficients it is possible to calculate the water loss from white pine seedlings from the evaporation from the atmometers.

Half shade reduces the transpiration and the evaporation, but the graphs show that the response of the plants and the atmometers is not identical. The decrease in water loss due to "shade" for the first part of August, 1913, was as follows: black atmometer 50 per cent., white atmometer 44 per cent., white pine seedling 70 per cent.

Plants grown under the three conditions studied showed great variation in structure, in the amount of ash, and their chemical composition. The amount of water transpired by the no-shade plants was many times that transpired by the

plants in half and full shade, but the per cent. of ash, figured on a dry matter basis, is less in these plants than in either of the other two sets of plants.

Relative Transpiration in Rain-forest and Desert Plants: Forrest Shreve.

Relative transpiration is defined as the ratio of the absolute transpiration of a unit area of leaf surface to the concurrent evaporation from a unit area of water. Its values give an index of the physiological controls of transpiration and of the action of light upon it. Relative transpiration and stomatal movement have been studied in several Jamaican rain-forest plants, with the general result that the two do not show a sufficiently close correlation to warrant the view that either is wholly controlled by the other.

A comparison of the rates of relative transpiration in rain-forest and desert plants shows them to be of the same order of magnitude in the two groups, as investigated under the conditions of their native environments, in Jamaica and in Arizona. Since the annual evaporation total in Arizona is ten times that in Jamaica, it follows that the absolute transpiration per unit area in plants of the desert is approximately ten times as great as it is in the rain-forest.

Seasonal Variations of the Osmotic Pressure of Pool, Pond and Stream Waters: Edgar N. Transeau.

Freezing-point determinations of the osmotic pressure of the natural waters of pools, ponds and small streams in central Illinois, made at intervals during the year 1913, have shown the following general results:

1. The osmotic pressure, expressed in millimeters of mercury, varied from 59 to 407.

2. The highest pressures were recorded during early spring when the water levels were highest.

3. The lowest records were made during the middle of September when the levels for the year were lowest.

4. Contrary to the statements often made, when the water level of ponds and pools lowers in late spring and summer, the osmotic pressure of the water is not increased, but is often greatly diminished.

5. When streams are reduced to pools, the water may have a higher pressure; as the pools dry up the pressure is diminished.

6. There are sudden and considerable variations in the pressure, sometimes coincident with weather changes, development or decay of algæ, etc., but sometimes without apparent connection with other known factors.

The year 1913 was an exceptionally favorable one for testing the relation between lowering water levels and concentration, as there were no rains of consequence between the middle of April and the middle of September.

Zoospore Formation in Characium acuminatum: Gilbert Morgan Smith.

The mature plant is multinucleate and contains 16, 32 or 64 nuclei at the time that zoospore formation takes place. In the growth of the alga the nuclear divisions are mitotic and all nuclei divide simultaneously. There may be more than one pyrenoid present and the shape of the pyrenoid is quite irregular. Very thin starch plates are found around the pyrenoid, while other plates of stroma starch, probably derived from the pyrenoid, are found scattered throughout the cytoplasm.

The zoospores are formed by progressive cleavage. Cleavage takes place by a furrowing in of the plasma membrane. The first cleavage furrows are transverse and then longitudinal cleavage furrows cut the protoplasm into multinucleate masses. These multinucleate masses are then cut into angular uninucleate protoplasts by further cleavage. There is no division of the pyrenoid, but it remains unchanged till cleavage has been completed, when it disappears. The angular uninucleate protoplasts then become ovoid and a pyrenoid is formed *de novo* in each one. These are the zoospores which are liberated by the rupture of the old mother cell wall.

A Preliminary Report on the Isolation and Identification of the Enzymes of Fucus vesiculosus: B. M. Duggar and A. R. Davis.

Peculiarities in the carbohydrate and nitrogen metabolism of the Fucaceæ make desirable a determination of the enzyme content of the growing tissues. Employing a variety of methods, no evidence has yet been found to indicate the presence of any of the commoner carbohydrases except cellulase. The commoner esterases are likewise absent, but amidases are well represented. Urea, especially, is rapidly transformed and urease is apparently widely distributed in the tissues. Oxidases have not been detected by any of the usual methods.

Relation of Certain Grass-Green Algæ to Elementary Nitrogen: Jacob R. Schramm.

The number of species of algæ in which free nitrogen fixation has been investigated under pure cultural conditions is relatively small—represent-

ing not more than four or five genera. By a pure culture here is understood one containing a single species of alga free from all other organisms. What work has been done with pure cultures has led invariably to the conclusion that these forms are unable to fix free atmospheric nitrogen both in the presence of and absence of combined nitrogen and energy-furnishing materials. It is by no means certain, however, that forms do not exist which under one or all of these conditions are able to utilize elementary nitrogen. This thought is especially justified when the small number of free nitrogen-fixing species among the bacteria are considered.

By a variety of methods approximately 25 species were isolated in pure culture. Of these, two were blue-greens, 2 diatoms, and the remainder grass-greens. Seven species of the latter were tested for free nitrogen fixation in the complete absence of combined nitrogen. The effect of a slightly elevated temperature was determined in a duplicate series maintained at a temperature of from 29.5 to 30.5° C.

No fixation was observed in any of the species and, unlike certain fungi, no favorable effect was exercised by the higher temperature.

Indications Respecting the Source of Combined Nitrogen Used by Ulva lactuca: G. L. FOSTER.

Laboratory cultures of *Ulva lactuca* in sea-water showed increased growth over that of the controls, when ammonium nitrate, urea or acetanide was added. Na-asparaginate did not increase the growth. Dimethylanilin and acetanilide were extremely toxic.

Parallel experiments in which the same compounds were added to artificial sea-water less nitrogen, gave similar results.

The Influence of Etherization on Certain Enzymatic Activities of Bulbs and Tubers: M. M. MCCOOL.

The experiments reported deal chiefly with the relative activity of diastases, oxidases and catalase in etherized and natural bulbs and tubers. Material from the two sources indicated differ materially in the activity of the enzymes. Diastatic action is greater in the etherized tissues; and this is also true for the action of oxidases and peroxidases. Catalase activity is, however, diminished by etherization.

On the Tracheary Origin of the Resin Tissue of the Conifers with Special Reference to Abies balsamea: R. B. THOMSON.

After a careful survey of the resin tissue in the whole Conifer series, the conclusion has been reached that the ligneous resin tissue of the Conifers owes its origin to the modification of tracheary elements. This seems self-evident when it is considered that the Cordaitean forms, from which the Conifers are generally conceded to have arisen, have wood which is wholly tracheary. This view is directly opposed to that of Penhallow, who regards the resin tissue as derived from parenchyma, a view which is no doubt responsible for the recent theory of Kirsch that the vertical resin canals of the pines are proliferated from the *parenchyma* of the medullary rays.

In *Abies* Penhallow found transitions between the parenchymatous cells of the resin cysts and parenchyma-shaped tracheary elements. These he interpreted as evidence of the transformation of parenchyma into tracheary elements, whereas the writer presents evidence to show that both these and the parenchyma elements are derivatives of tracheids, the chief point being that these elements or combinations of them and the parenchymatous ones are *in vertical series coterminous* and *in the same radial sequence with ordinary tracheids.* They are thus derived from the same cambial cell which ordinarily gives rise to a tracheid. The modification occurs in association with the medullary rays, which are the only source of preservative in the most ancient fossil woods.

Cycad Pitting: H. B. SIFTON.

The pits on different parts of individual tracheids of the Cycads differ. The terminal ones, and those on the sides touching parenchyma tissue are more primitive than the others. In arrangement the pits are opposite or alternate indiscriminately, and are even quite commonly scattered or in small groups of two or three, facts which show that the arrangement of pits is not a feature of so great phylogenetic importance as has been thought. In cases of scattered or group pitting, there is present a probable precursor or primitive form of the "bars" or "rims" of Sanio, structures which have not been previously described in the Cycads, the only group of living Gymnosperms in which they have not been found.

A reexamination of type material of *Cordaites missouriense* (*C. illinoisense*) reveal several important features not mentioned in Penhallow's brief description.

The pitting is more primitive near the ends of the tracheids, and beside the medullary rays, than on other parts. This is shown by an increase in the number of rows of pits, and by the greater

dimensions of the pores. As many as six rows may be found where the tracheid touches the ray cell, and here the pores may extend considerably beyond the border of the pits. Again, in arrangement, the pits, though usually alternate, may be opposite, and are often scattered.

One remarkable feature is that many tracheids have bent ends, usually at the rays. These bent ends reach over several tracheids, and thus afford a means for radial conduction. Such tracheids have long been known in the Araucarineæ and are considered to be ancestral to true ray tracheids. They are for the first time described in a Cordaitean form.

Trabeculæ are present in many tracheids; a feature which has not been noted previously among Cordaitean forms. Peculiar wandering parenchymatous cells are also found associated with the medullary rays.

Tyloses: A Study of Their Occurrence and Practical Significance in Some American Woods: Eloise Gerry.

In this study of the occurrence of tyloses in wood from trees of commercial size grown in the United States, 203 specimens were examined. The 143 specimens of hardwoods include 94 species belonging to 45 genera, 24 of which contained tyloses. The 60 specimens of conifers included 45 species belonging to 13 genera, 1 of which contained tyloses. Of the total 139 species examined, 56 belonging to 25 genera[2] contained tyloses.

Tyloses were found in the sapwood of all the species where their presence was established in the heartwood.

Well-developed tyloses were found in the outermost rings near the bark of 30 species of hardwoods.

True tyloses occur in the wood tracheids of certain pines, principally of the white pine group.

Epithelial cells sometimes effect a partial or even a complete tylose-like closing of the resin canals in *Pinus, Larix, Picea* and *Pseudotsuga.*

A considerable proportion of the vertical canals, even in the heartwood of the pines, are wholly or partly open.

Tyloses act like a natural filler in the hardwoods.

The woods where tyloses are abundant are, as a rule, durable.

[2] *Æsculus, Fagus, Liquidambar, Liriodendron, Magnolia, Oxydendrum, Platanus, Populus, Salix, Castanea, Catalpa, Celtis, Chilopsis, Eucalyptus, Fraxinus, Hicoria, Juglans, Morus, Quercus, Rhus, Robinia, Sassafras, Toxylon, Ulmus, Pinus.*

Tyloses, because they are very impermeable to air, water and creosote, reduce the penetrance of the woods in which they are strongly developed, thus decreasing, for instance, the tendency for such woods to become water-logged.

The presence of tyloses closing the vessels of a hardwood does not, however, prevent the penetrance of a preservative such as creosote into the other wood elements.

(*To be concluded*)

George T. Moore,
Secretary

SOCIETIES AND ACADEMIES

THE TENNESSEE ACADEMY OF SCIENCE

The annual meeting of the Tennessee Academy of Science was held in Furman Hall, Vanderbilt University, Nashville, Tenn., on November 28, 1913. President Watson Selvage delivered an address relative to the aims and purposes of the Academy, and the following papers were read and discussed:

"A Natural Bridge of Tennessee in Process of Formation," by H. D. Miser.

"Physiographic Features of Tennessee," by L. C. Glenn.

"Development of the Phosphate Industry in Tennessee," by Lucius P. Brown.

"Caverns and Rock Shelters of the Cumberland Valley," by W. E. Myer.

"Food Preservation," by L. C. Bliss.

"A New Geological Map of Tennessee," by A. H. Purdue.

"Some Neglected Principles of Physiography," by A. H. Purdue.

"Some Early Topographic Maps," by L. C. Glenn.

The following officers were elected for the ensuing year:

President—L. C. Glenn, Vanderbilt University, Nashville.

Vice-president—W. E. Myer, Carthage.

Secretary—Roscoe Nunn, 1235 Stahlman Building, Nashville.

Treasurer—Archibald Belcher, Middle Tennessee Normal School, Murfreesboro.

Editor—James A. Lyon, Southwestern Presbyterian University, Clarksville.

The president appointed as members of the executive committee, S. M. Bain, University of Tennessee, Knoxville, and E. J. McCroskey, Lebanon.

Roscoe Nunn,
Secretary